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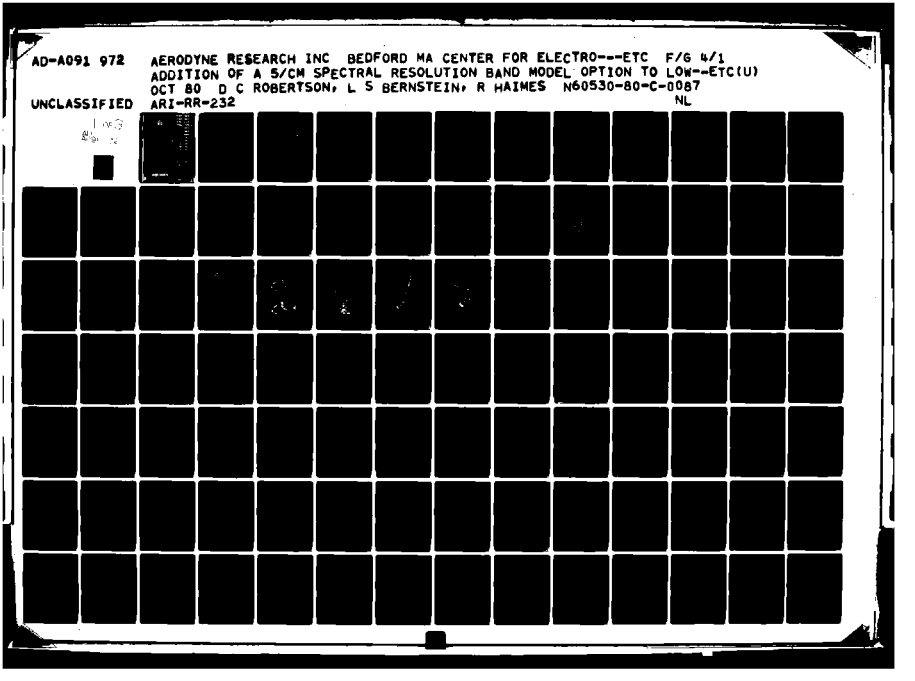

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ADDITION OF A 5 cm^{-1} SPECTRAL RESOLUTION BAND MODEL OPTION TO LOWTRAN

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ADDITION OF A 5 cm^{-1} SPECTRAL RESOLUTION BAND MODEL OPTION TO LOWTRAN5

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents a modified version of the atmospheric transmission and radiation code LOWTRAN5, which includes: (1) an increase in the spectral resolution from 20 to 5 cm^{-1}, (2) the addition of temperature dependent molecular absorption coefficients, and (3) the use of a multi-parameter, Doppler-Lorentz band model for calculation of molecular transmittance. A set of 5 cm^{-1} band model parameters have been developed using the molecular data in the Air Force Geophysics Lab HITRAN line compilation for the major atmospheric absorbers (CO_2, N_2O, CO, CH_4, O_3, O_2, H_2O).

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The absorption coefficient, S/d, and line density, 1/d, band model parameters were determined at 5 cm^{-1} resolution from 400-10,000 cm^{-1} (1-25 μm) and at 200, 225, 250, 275, and 300K. Examples of these parameters for H_2O and the uniformly mixed gases are presented. In addition to the S/d and 1/d band model parameters, the need for and determination of the molecular continuum absorption due to the tails of lines originating outside a given spectral interval are presented.

Comparisons of LOWTRAN5 transmittance and radiance calculations with the modified version, LOWTRAN5(BMOD), are shown and discussed. Comparison of predictions using both versions of LOWTRAN5 with transmittance and radiance measurements are included.

A detailed set of appendices are included which cover instructions for the required modifications to LOWTRAN5, implementation directions, program listings, and test cases.

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ACKNOWLEDGEMENT

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1. INTRODUCTION

The LOWTRAN5 computer code[1] and its predecessors, LOWTRAN2, 3, 3B and 4[2,3,4,5], developed by the Air Force Geophysics Laboratory (AFGL), are widely used to calculate atmospheric transmittance and radiation in the 0.25-28 μm spectral region at a resolution of 20 cm^{-1}. These codes include the effects of scattering and absorption by atmospheric molecules and aerosols. LOWTRAN5 is easily used and allows the user considerable flexibility in selecting model atmospheres, aerosol type and distribution, local radiosonde data and atmospheric paths. The spectral resolution is determined by the model used for molecular line absorption and emission, since the other components, molecular continuum absorption and aerosol extinction, exhibit a slowly varying spectral structure. For calculational efficiency LOWTRAN5 utilizes temperature-independent molecular absorption coefficients and approximates molecular line absorption by a one-parameter band model which has a spectral resolution of 20 cm^{-1}. This paper discusses a modified version of LOWTRAN5 which includes, (1) an increase in the spectral resolution from 20 to 5 cm^{-1}, (2) the addition of the temperature dependence of the molecular absorption coefficients, and (3) the use of a multi-parameter, Doppler-Lorentz band model for calculation of molecular transmittance. All other LOWTRAN5 features such as aerosol models, molecular and aerosol scattering, continuum components and refractive effects remain unchanged.

The use of band model approximations in atmospheric transmittance calculations has been thoroughly reviewed by Anding[6] (1967) and more recently by LaRocca and Turner[7] (1975). The most recent contributions to this area, which are not covered in the reviews, includes work by Aoki,[8] Greunzel,[9] and Pierluissi et al.[10] The main contribution of this effort is a synthesis of previous theoretical formulations into an entirely theoretical, unique model incorporated into an operational version of LOWTRAN5. The primary features of the model include:

1. Temperature dependent absorption coefficients and line density parameters;
2. Explicit evaluation of the exact expression for the equivalent width of a Voigt line in a finite spectral interval,
3. Inclusion of the molecular continuum absorption due to the tails of lines originating outside a given spectral interval,
4. Relatively high spectral resolution (5 cm^{-1}) for a band model,
5. Temperature and frequency dependent collision broadened linewidths, and,
6. Power law approximation to the transmittance of a finite number of lines.

The 5 cm^{-1} band model parameters have been developed using the molecular data in the AFGL HITRAN[11] line atlas for the major atmospheric absorbers (CO_2, N_2O, CO, CH_4, O_3, O_2, H_2O). The absorption coefficient, S/d, and line density, 1/d, band model parameters were determined at 5 cm^{-1} resolution from 400-10,000 cm^{-1} (1-25 μm) and at 200, 225, 250, 275, and 300K.

A combined Doppler-Lorentz band model is used to approximate the change in molecular transmittance due to the altitude dependence of the lineshape. The Curtis-Godson[12, 13] approximation is used for multilayered transmittance calculations.

The philosophy for incorporating the 5 cm^{-1} band model option, hereafter referred to as BMOD, has been to minimize all coding changes to LOWTRAN5. While developing BMOD, and interfacing it with LOWTRAN5, it was found that some minor changes to the code would increase its overall utility. As a result, the code modifications presented in this report are divided into two categories: those required to implement the BMOD option and optional changes which increase the code's general usefulness or its compatibility with different machines. The required and optional changes are indicated in the listing (Appendix D) with an asterisk and a colon respectively as part of the sequence number.

The BMOD option requires the addition of six subroutines and the use of an external disc or tape file which contains the band model parameters. The BMOD option is activated by an additional input parameter (JBMOD) which has been added to Card 1 and by allowing access to a binary file with the band model parameters. Otherwise, the usual LOWTRAN four-card sequence of data cards is unchanged, unless the Print/Plot Package described below is used.

Optional changes to the program include a Print/Plot Package, generalization of some statements, and inclusion of a blackbody source term. As part of the Print/Plot Package the results calculated at 5 cm^{-1} resolution can be degraded through a user-specified slit function; the results are printed in tabular form. The user can request transmittance and/or radiance plots as a function of either wavenumber or wavelength. Several LOWTRAN5 statements have been generalized to a more standard FORTRAN format which should increase the ease of implementation. A background blackbody source, which previously was restricted to reside at sea level, can now be located at any altitude.

This report provides description and documentation for implementing the 5 cm^{-1} capability into LOWTRAN5. This report is intended as a supplement to the LOWTRAN5 Users' Manual.[1] The molecular transmittance model and the band model parameters used in BMOD are presented in Section 2. The modifications to the LOWTRAN5 code are described in Section 3. Input instructions are given in Section 4. The appendices consist of a detailed description of the Print/Plot Package, flowcharts for the additional subroutines, a list of variables, a complete program listing, sample cases with input and output, and a narrative description for implementing the BMOD option to LOWTRAN5.

Comparison of the execution time for cases run with and without the BMOD option are presented in Table 1. Our experience on the Aerodyne PRIME 400 computing system is that the 5 cm^{-1} capability is roughly a factor of two to four slower than the regular LOWTRAN5.

TABLE 1 - ILLUSTRATIVE RUN TIMES ON PRIME 400 COMPUTER

PATH	GROUND TO SPACE (33 LAYERS)		GROUND TO SPACE (33 LAYERS)	
CALCULATION	TRANSMITTANCE		TRANSMITTANCE AND RADIANCE	
WAVENUMBERS.	400 - 9995 cm^{-1} (5 cm^{-1} STEPS)		1900 - 2500 cm^{-1} (5 cm^{-1} STEPS)	
TIME	CPU	I/O*	CPU	I/O*
LOWTRAN5	51 sec	19 sec	25 sec	4 sec
BMOD OPTION	220 sec	21 sec	86 sec	8 sec

*JP = 0, Full LOWTRAN5 printout.

2. MOLECULAR TRANSMITTANCE MODEL

2.1 Single Line Equivalent Width

The expression used in the modified LOWTRAN5 code to calculate molecular transmittance is based on a statistical model[14,15,16] for a finite number of lines in a finite spectral interval, and is given by

$$\tau = \left[1 - (\bar{W}_{s\ell}/nd)\right]^n \tag{1}$$

where τ is transmittance, $\bar{W}_{s\ell}$ is the average of the single line equivalent width over the line strength distribution in the spectral interval, n is the effective number of lines, and d is the mean line spacing. The number of lines is related to the spacing by

$$n = \Delta\omega/d \tag{2}$$

where $\Delta\omega$ is the width of the interval. For large values of n, generally $n > 10$, Eq. (1) simplifies to a more recognizable exponential form given by

$$\lim_{n \to \infty} \tau = \exp(-\bar{W}_{s\ell}/d) \quad . \tag{3}$$

For the molecular species and relatively low temperatures encountered in the Earth's atmosphere, the spectral line density is sufficiently small (generally $n < 10$ for $\Delta\omega = 5\ cm^{-1}$), so that the power law transmittance approximation in Eq. (1) is preferred.

There are many approximations available[17] for calculating the equivalent width; the different approximations are valid for different regimes, Doppler or collision broadening, weak line or strong line, etc. However, no single approximation is adequate for the range of pressures and optical pathlengths encountered in atmospheric transmission calculations. Rather than incorporate different approximations, we directly evaluate the exact expression for the equivalent width of a single line with a Voigt lineshape; $W_{s\ell}$ is given by

$$W_{s\ell} = (2\gamma_D/(\ln 2)^{1/2}) \int_0^{x_m} \left(1 - \exp\left\{-(Su/\gamma_D)(\ln 2/\pi)^{1/2} F(x,y)\right\}\right) dx \quad (4a)$$

$$F(x,y) = \frac{y}{\pi} \int_{-\infty}^{\infty} \frac{\exp(-t^2)}{y^2+(x-t)^2}\, dt \quad (4b)$$

$$x = (\ln 2)^{1/2} (\omega-\omega_o)/\gamma_D$$

$$y = (\ln 2)^{1/2} \gamma_C/\gamma_D \quad (4c)$$

where γ_D is the Doppler linewidth, γ_C is the collision broadened linewidth, S is line strength, u is optical pathlength, ω is frequency, x is dimensionless frequency, y is dimensionless linewidth, and F(x,y) is the Voigt lineshape function. Numerical integration of Eq. (4a) from 0 to x_m is extremely time consuming; however, it is not necessary to numerically integrate over the entire interval. There is always a value of x, say x_ℓ, beyond which the asymptotic expression for F(x,y) is quite accurate and is given by

$$\lim_{x \to \infty} F(x,y) = \frac{y}{\sqrt{\pi} x^2} \quad . \tag{5}$$

Thus, Eq. (4a) can be numerically integrated up to x_ℓ, and from x_ℓ to x_m the integration is given directly by

$$\int_{x_\ell}^{x_m} \exp(-\beta^2/x^2)\,dx = \beta \left[\frac{e^{-z_m^2}}{z_m} - \frac{e^{-z_\ell^2}}{z_\ell} + \sqrt{\pi} \left\{ \mathrm{erf}(z_m) - \mathrm{erf}(z_\ell) \right\} \right]$$

$$\beta = \sqrt{(Su/\gamma_D)(\ln 2/\pi)^{1/2}(y/\sqrt{\pi})} \tag{6}$$

$$z = \beta/x$$

where the error function, erf(z), is evaluated by a rational approximation.[18] For evaluation of F(x,y) in the numerical integration, an algorithm developed by Humlicek[19] is used. At lower altitudes, where collision broadening predominates, x_ℓ is of order 10^2 and at higher altitudes, where Doppler and collision broadening are comparable, an x_ℓ of 3 or less is usually sufficient. A typical value of x_m, for $\Delta\omega/2 = 2.5$ cm^{-1}, is $x_m \approx 10^3$.

At altitudes where Doppler broadening predominates ($y < 10^{-3}$) the equivalent width integral is approximated as the sum of a pure Doppler ($y = 0$) equivalent width and the asymptotic contribution with $x_\ell \simeq 3$, where the Doppler equivalent[17] width is given by

$$\lim_{y \to 0} W_{s\ell,D} \simeq (2/\ln 2)^{1/2}\, \gamma_D \sqrt{\ln \left\{ 1 + (\ln 2/2)\,(Su/\gamma_D)^2 \right\}} \quad . \tag{7}$$

2.2 Curtis-Godson Approximation

Paths through a real atmosphere usually pass through regions of changing pressure, temperature and/or concentration. The Curtis-Godson[12,13] approximation replaces an inhomogeneous path with a homogeneous one by using average values for the equivalent width and transmittance parameters. The Curtis-Godson approximation is very good for paths where the temperature or species gradient is not particularly steep. This is certainly the case for atmospheric paths where the temperature variations for arbitrary paths fall within the range of 200 to 300K. The total optical depth is a sum over contributions from the individual layers and is given by

$$(S/d)u = \sum_i (S/d)_i \, \Delta u_i \tag{8}$$

where Δu_i is the incremental optical path and $(S/d)_i$ is the average molecular absorption coefficient for the i'th layer. This quantity is used as the weighting function in calculating the mean value of γ/d, which is given by

$$\overline{(\gamma/d)} = \sum_i (\gamma/d)_i \, (S/d)_i \, \Delta u_i / (S/d)u \quad , \tag{9}$$

where γ stands for either γ_C or γ_D. The average values of the line density, 1/d, and total number of lines, n, are analogously defined. The equivalent width is calculated with

$$\frac{Su}{\gamma_D} = (S/d)u / \overline{(\gamma_D/d)} \quad , \tag{10}$$

and the transmittance is computed with

$$\bar{n} = \Delta\omega \, \overline{(1/d)} \tag{11}$$

2.3 Line Wing Absorption

The transmittance, as approximated by Eq. (1), takes into account only lines which originate within the spectral interval, and, for these lines, only the fraction of the line profile which falls within the interval is included in the computation of the equivalent width by Eq. (4a). This approximation is reasonable in the strongly absorbing region of a band; however, because the absorptivity is expressed in terms of the local line strength distribution, it becomes a poor approximation in regions where the lines are weak or nonexistent. This typically occurs in the center and far wings of a band (i.e., past the band head), and also in spectral intervals containing no lines which are in the vicinity of isolated strong lines. For these situations, the local absorption is dominated by the accumulated tails of the stronger lines originating outside the interval. The effect of line wing absorption is included in the transmittance by

$$\tau = \left[1 - (\bar{W}_{s\ell}/nd)\right]^{n} \exp(-C_m u) \tag{12}$$

where C_m is the molecular line wing continuum absorption coefficient. The determination of C_m is discussed in a later section.

2.4 S/d and 1/d Parameters

The S/d and 1/d band model parameters were generated from the AFGL HITRAN line atlas by[7,11]

$$S/d(\omega, T) = \left[\sum_i S_i(T)\right] \Big/ \Delta\omega$$

$$1/d(\omega, T) = \left[\sum_i \sqrt{S_i(T)}\right]^2 \Big/ \left[\Delta\omega^2 \, S/d(\omega, T)\right] \tag{13}$$

where $S_i(T)$ is the integrated line strength of the i'th transition at temperature, T, and $\Delta\omega$ is the spectral resolution. The sums in Eq. (13) are subject to the constraint that the line center, ω_i, of each transition included fall within the spectral interval, $\omega - \Delta\omega/2 \leq \omega_i \leq \omega + \Delta\omega/2$. The line strength at an arbitrary temperature, can be scaled from the HITRAN line strength at a reference temperature, T_o, by

$$S_i(T) = \frac{Q_v(T_o)Q_r(T_o)}{Q_v(T)Q_r(T)} \exp\left[-E_i(T_o-T)/(kT_oT)\right] \times \left\{\left(1 - \exp\left[-hc\omega_i/(kT)\right]\right)\Big/\left(1 - \exp\left[-hc\omega_i/(kT_o)\right]\right)\right\} S_i(T_o) \tag{14}$$

where Q_v and Q_r are the vibrational and rotational partition functions, and E_i is the energy of the lower transition state.

The S/d and 1/d parameters were computed at 5 cm^{-1} resolution from 400 to 10,000 cm^{-1} (1-25 μm) and at 200, 225, 250, 275, and 300K. Following the LOWTRAN format, the band model parameters of the uniformly mixed gases (CO_2, N_2O, CO, CH_4, O_2) were combined according to atmospheric mixing ratio, χ_m, by

$$S/d_{umix} = \left[\sum_m \chi_m \sum_i S_{im}\right]\Big/ \Delta\omega$$

$$1/d_{umix} = \left[\sum_m \sqrt{\chi_m} \sum_i \sqrt{S_{im}}\right]^2 \Big/ \left[\Delta\omega^2\ S/d_{umix}\right] \quad . \tag{15}$$

Band model parameters for the nonuniformly mixed gases, H_2O and O_3, were calculated individually according to Eq. (13). For the uniformly mixed species an average molecular weight $\bar{M}_{umix}$, and line broadening parameter,

$\bar{\alpha}_{umix}$, were also determined, as they are required in the evaluation of the Doppler-Lorentz curve-of-growth. These quantities were calculated as line strength weighted averages by

$$\bar{M}_{umix} = \left[\sum_m M_m \chi_m \sum_i S_{im}\right] \Big/ \left[\sum_m \chi_m \sum_i S_{im}\right] \tag{16}$$

where an analogous expression was used for $\bar{\alpha}_{umix}$.

2.5 Line Wing Continuum Absorption Coefficients

The approximate contribution of the line tail absorption in the k'th spectral interval is given by

$$C_m(T, P, \omega_k) = \frac{P}{P_o} \sqrt{\frac{T_o}{T}} \frac{\Delta\omega}{\pi} \sum_{i \neq k} \frac{s/d(\omega_i, T)\ \gamma_i^o}{(\omega_i - \omega_k)^2} \chi(\omega_i - \omega_k) \tag{17}$$

where $\chi(\omega_i - \omega_k)$ is a form factor expressing deviation from Lorentzian behavior, and the sum is over all spectral intervals, i, excluding i = k. We have calculated $C_m(T, P, \omega_k)$ for all the bands of H_2O and CO_2 on the same wavenumber and temperature grid as the S/d and 1/d parameters. For the CO_2 bands the Burch[20,21,22] form factor was used, while for the H_2O bands 250 cm^{-1} Lorentz tails were assumed.

2.6 Examples of Band Model Parameters

Examples of the S/d (molecular absorption coefficient) and 1/d (line density) band model parameters and the continuum absorption coefficients for the uniformly mixed gases and H_2O are shown in Figs. 1 through 5. The temperature variation of the S/d parameter for the uniformly mixed gases in the

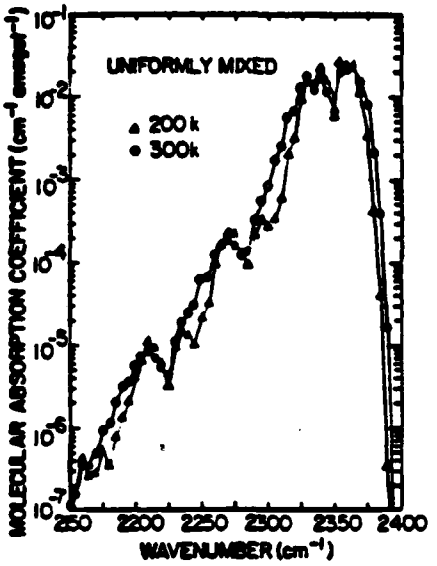

Figure 1. Temperature Dependence of the Uniformly Mixed Gas Molecular Absorption Coefficient.

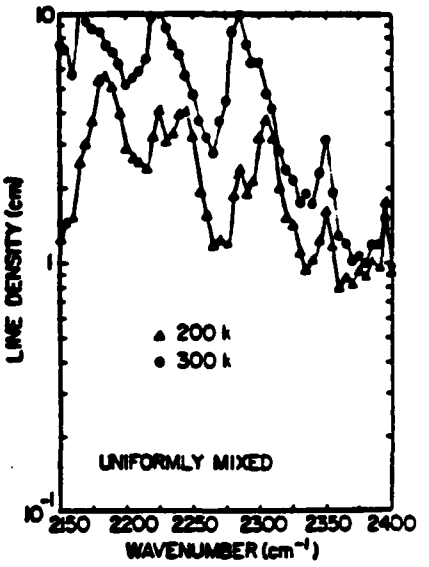

Figure 2. Temperature Dependence of the Uniformly Mixed Gas Line Density Parameter.

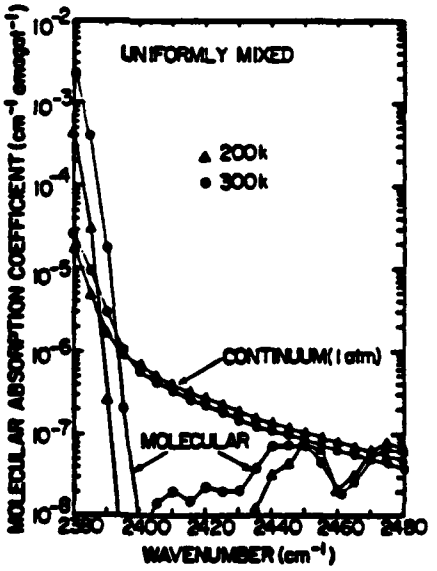

Figure 3. Temperature Dependence of the Uniformly Mixed Gas Molecular and Continuum Absorption Coefficients in the Band Head Region of the 4.3 μm CO_2 Band.

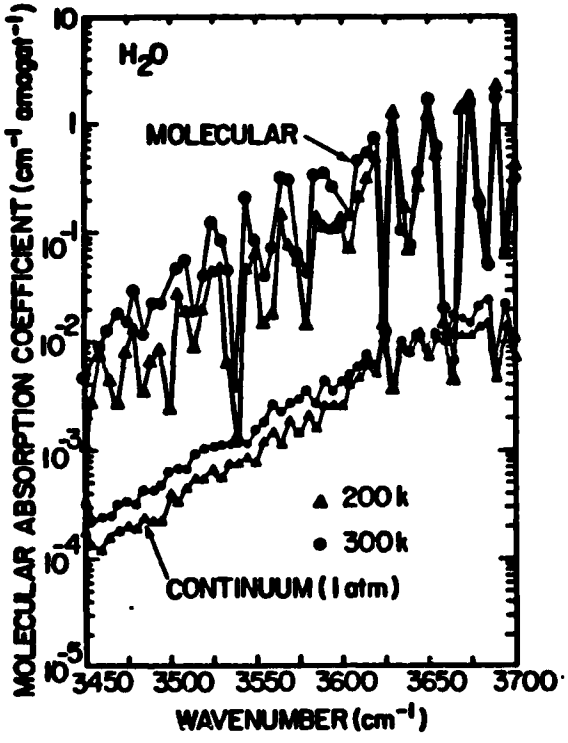

Figure 4. Temperature Dependence of the H_2O Molecular and Continuum Absorption Coefficients.

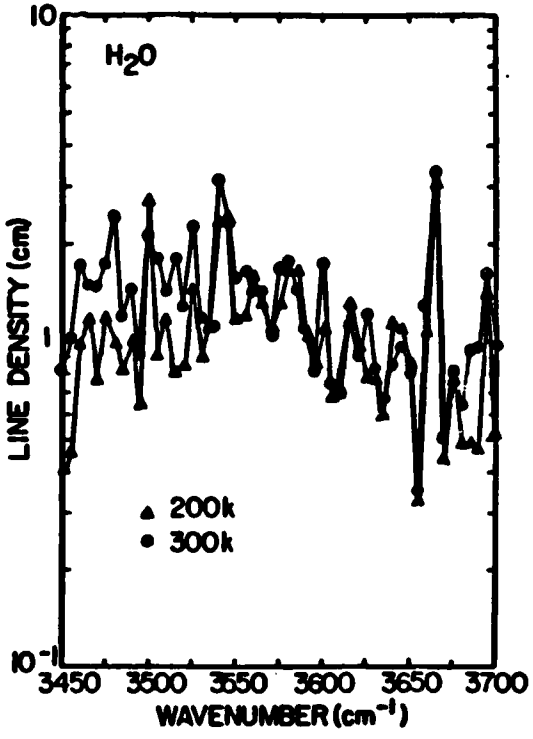

Figure 5. Temperature Dependence of the H_2O Line Density Parameter.

spectral region of the 4.3 μm CO_2 absorption is found in Fig. 1. A significant temperature variation is seen to occur throughout this region for the range of atmospheric temperatures typically encountered below 100 km altitude. In atmospheric transmission calculations, the band model parameters at intermediate temperatures are determined by linear extrapolation from the tabulated values at 200, 225, 250, 275, and 300K. The temperature dependence of the line density, 1/d, parameter in the 4.3 μm region is displayed in Fig. 2. The spectral region about the band head of the CO_2 4.3 μm band has been previously studied because of its potential use for satellite sounding of atmospheric temperature and density.[23,24] The relative contribution of the molecular and continuum absorption coefficients in this spectral region are shown in Fig. 3. There is a strong temperature dependence of the molecular absorption coefficients from 2380-2400 cm^{-1}, about an order of magnitude variation from 200 to 300K. A much weaker temperature dependence is calculated for the continuum absorption. The continuum component below 2380 cm^{-1} is typically two or more orders of magnitude smaller than the molecular absorption coefficient. The molecular and continuum absorption coefficients for the low wavenumber portion of the 2.7 μm H_2O band are shown in Fig. 4. In several of the pronounced micro-window regions, such as 3535, 3625, and 3665 cm^{-1}, the continuum absorption is comparable to the molecular absorption. The line density parameter for the 2.7 μ m H_2O band is found in Fig. 5.

2.7 Comparisons of LOWTRAN5 and LOWTRAN5(BMOD)

Examples of transmittance and radiation calculations with the LOWTRAN5 and LOWTRAN(BMOD) options are displayed in Figs. 6 through 15. These comparisons highlight the similarities and differences between the two options for a variety of atmospheric paths. It is apparent that if the 5 cm^{-1} BMOD calculations were degraded to the 20 cm^{-1} LOWTRAN5 calculations, the overall agreement would be quite good. However, at 5 cm^{-1} resolution, large deviations from the lower resolution calculations occur. The horizontal path transmittances in Figs. 6 through 9 demonstrate the altitude dependence of the two

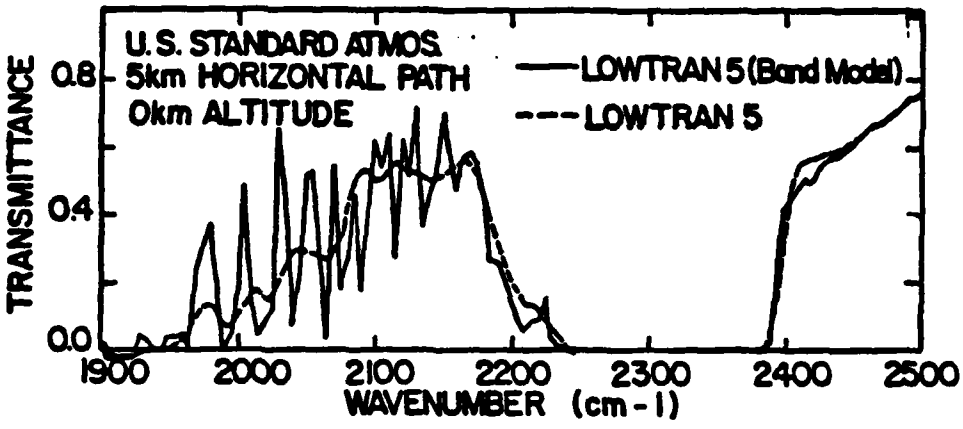

Figure 6. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for a 5 km Horizontal Path at 0 km Altitude.

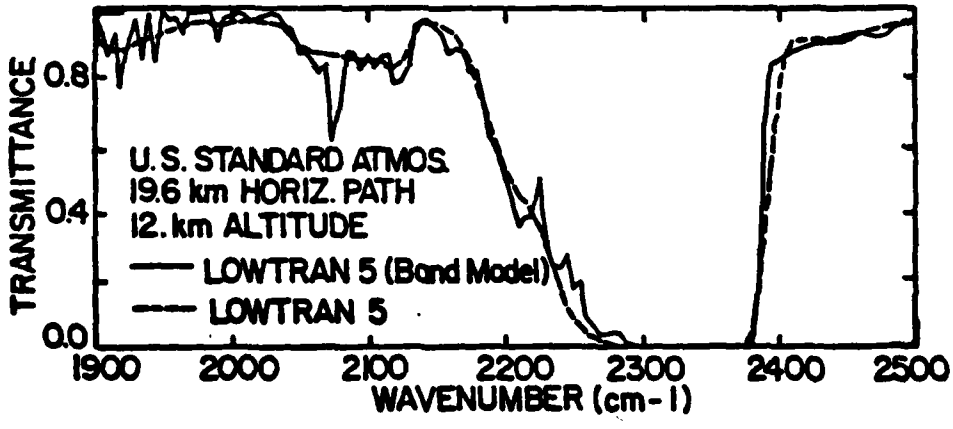

Figure 7. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for a 19.6 km Horizontal Path at 12.0 km Altitude.

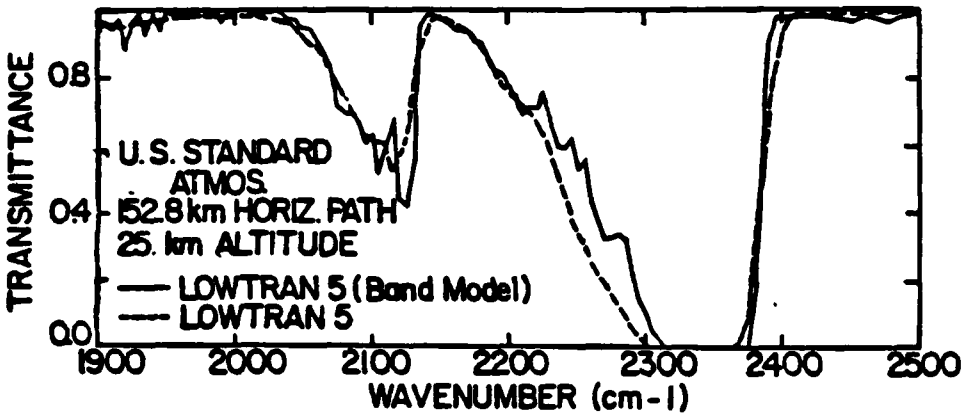

Figure 8. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for a 152.8 km Horizontal Path at 25.0 km Altitude.

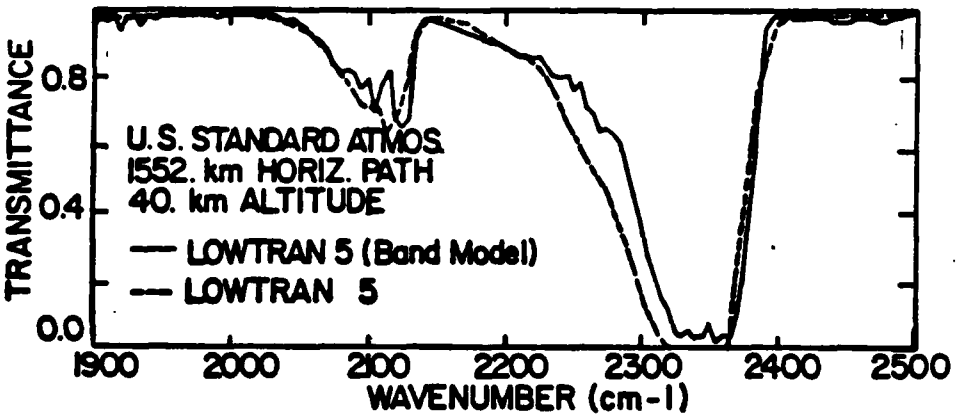

Figure 9. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for a 1552. km Horizontal Path at 40.0 km Altitude.

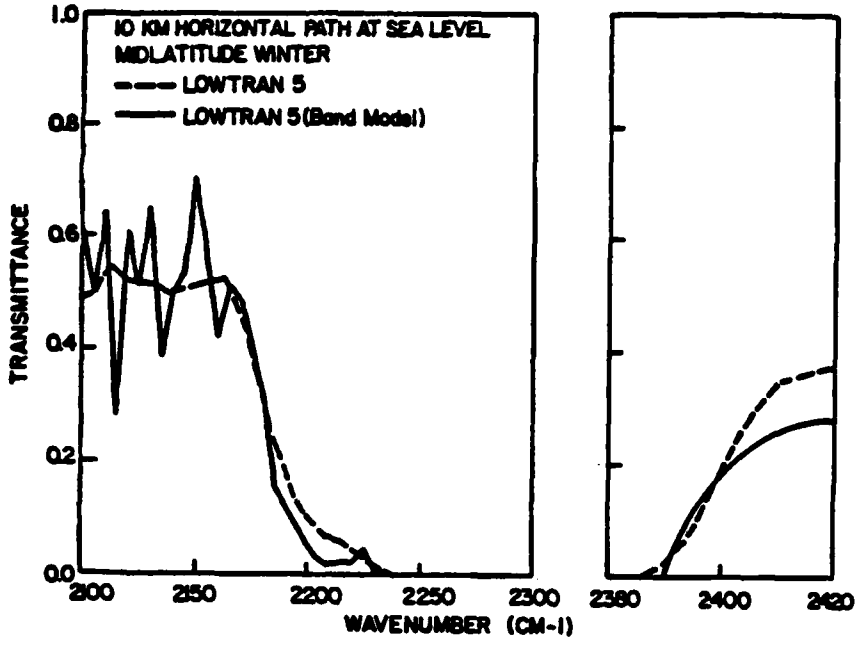

Figure 10. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for the Wings of the 4.3 μm CO_2 Band.

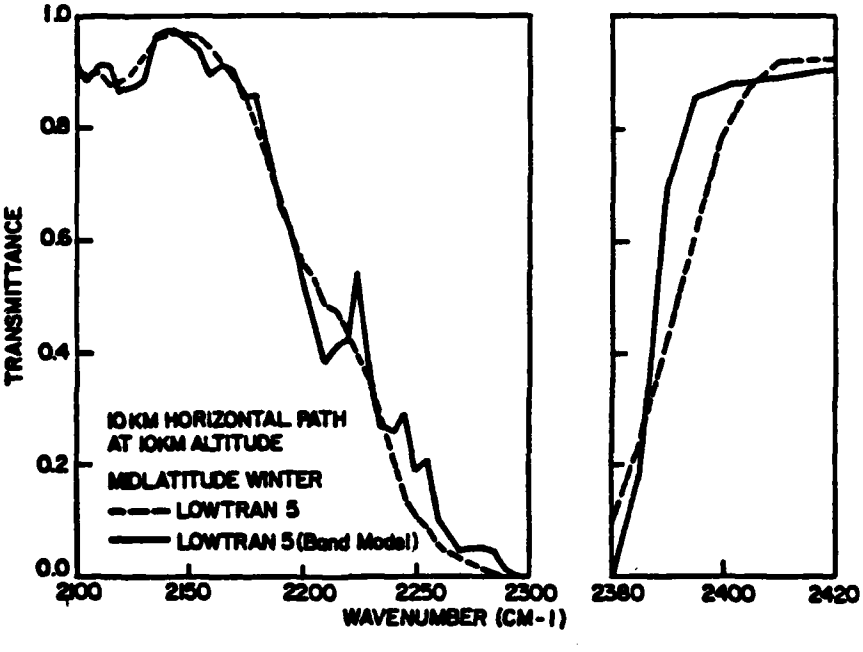

Figure 11. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for the Wings of the 4.3 μm CO_2 Band.

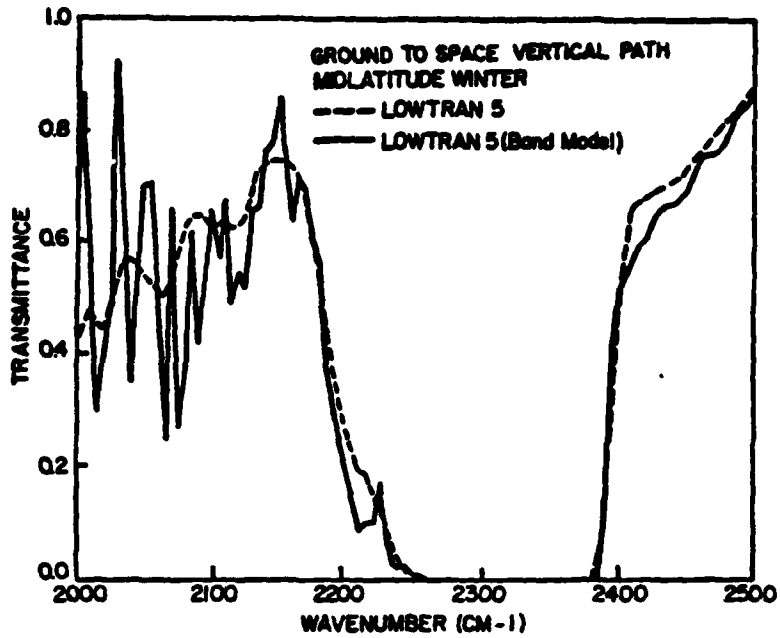

Figure 12. Comparison to LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for a Ground to Space Vertical Path.

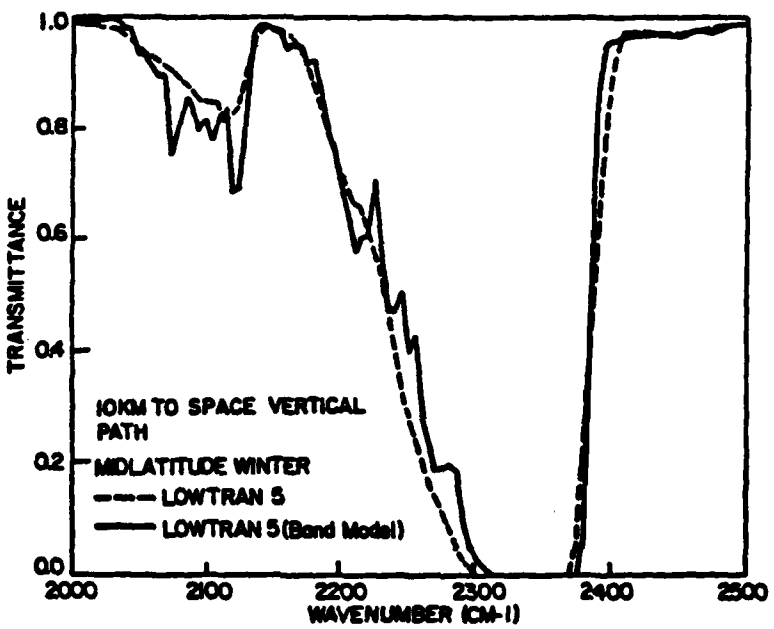

Figure 13. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Atmospheric Transmission Predictions for a 10 km to Space Vertical Path.

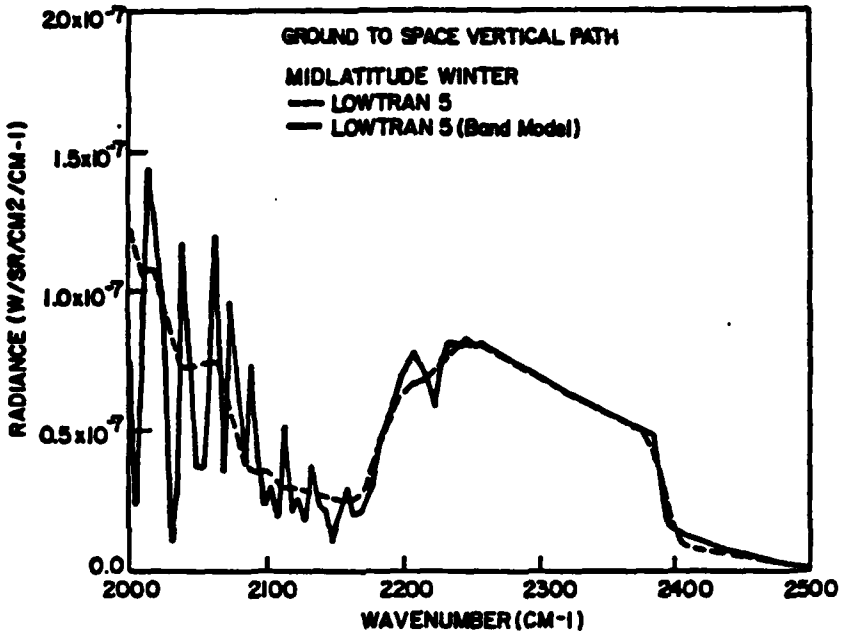

Figure 14. Comparison of LOWTRAN5 (Band Model) to LOWTRAN5 Background Radiance Predictions for a Ground to Space Vertical Path.

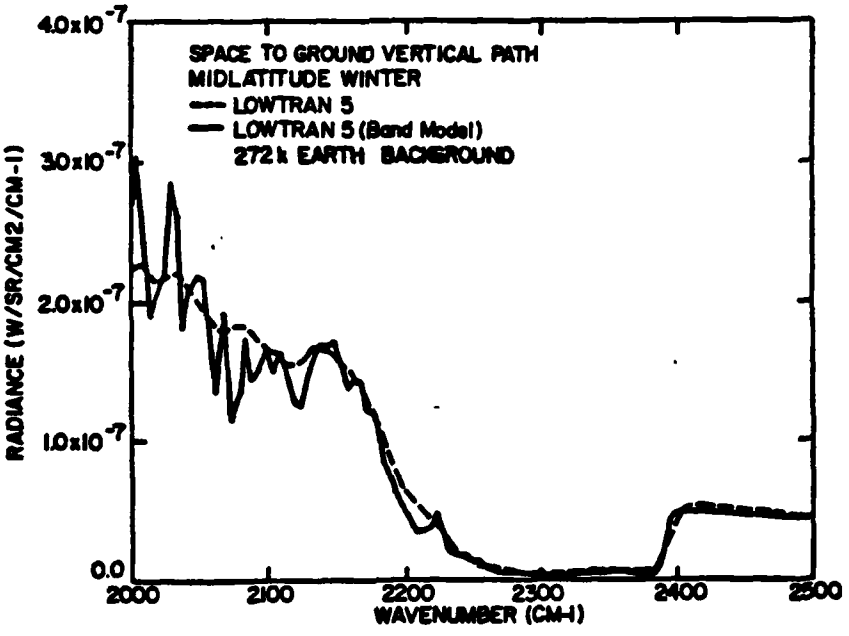

Figure 15. Comparison of LOWTRAN5 (Band Model) to LOWTRAN5 Background Radiance Predictions for a Space to Ground Vertical Path.

options. The path lengths at each altitude were chosen to give an identical molecular column density for the uniformly mixed gases. The increased transmittance with increased altitude is chiefly due to curve-of-growth effects. That is, as altitude increases, the molecular linewidth decreases, and the centers of lines become more opaque while the wings become more transparent. The differences between the two models reflect different curve-of-growth formulations. In LOWTRAN5, the one parameter curve-of-growth, reduces to the familiar weak and strong line limits, for small and large absorber amounts respectively, which is essentially a collisional broadening transmittance model. In LOWTRAN5(BMOD), the equivalent width calculation includes both collisional and Doppler broadening effects.

2.8 Comparison of LOWTRAN5 Models to Measurements

Comparison of LOWTRAN5 predictions for both the 20 cm^{-1} and 5 cm^{-1} options with transmittance and background radiance measurements are shown in Figs. 16 through 21. In Figs. 16 and 17 the LOWTRAN5 predictions are compared to transmission data obtained by AFGL (Sandford, et al.)[25] in the vicinity of Johnston Island. It is seen that the LOWTRAN5(BMOD) results closely follow the 4 cm^{-1} interferometric data. In Fig. 18, the LOWTRAN5(BMOD) predictions generally follow the 2 cm^{-1} General Dynamics (Blay et al.)[26] transmission data, although, there is a significant discrepancy around 2.3 μm. Similar calculations with LOWTRAN5 have compared better with the data in this region, which suggests that some H_2O lines may be missing from the HITRAN compilation in this region. Background radiance predictions are compared to measurements[27,28,29] in Figs. 19 through 21, where the LOWTRAN5(BMOD) calculations closely parallel the data in all cases.

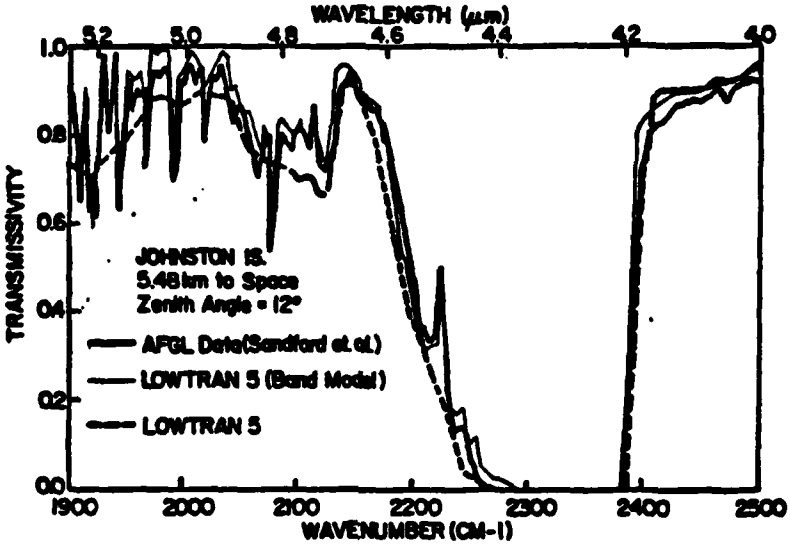

Figure 16. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Predictions to AFGL Transmission Measurements[25] for a 5.48 km to Space Path with a 12° Zenith Angle.

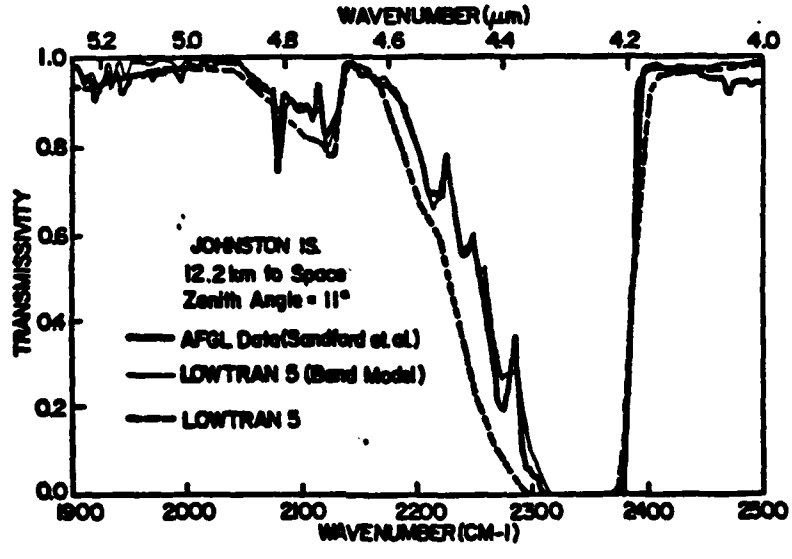

Figure 17. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Predictions to AFGL Transmission Measurements[25] for a 12.2 km to Space Path with a 11° Zenith Angle.

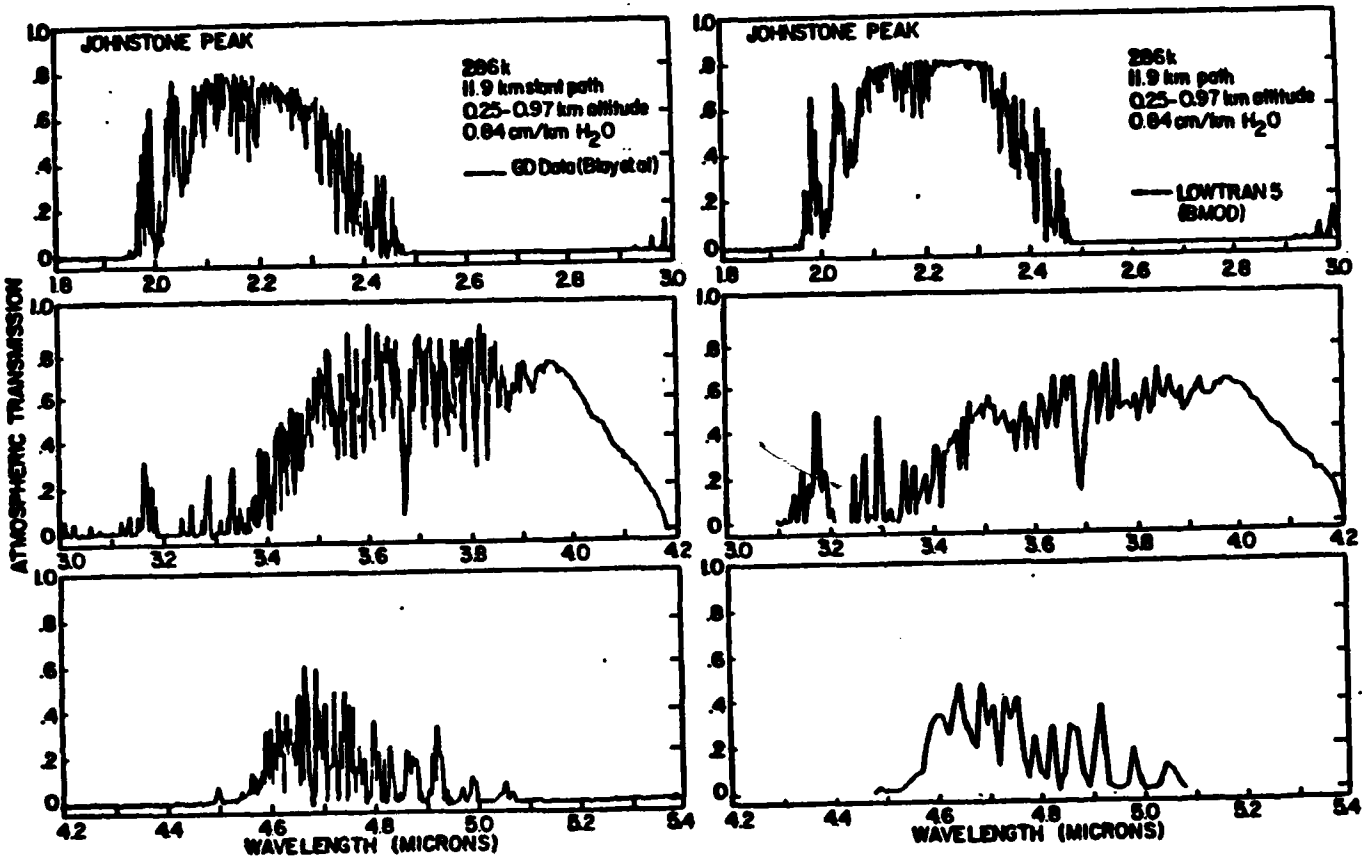

Figure 18. Comparison of LOWTRAN5 (Band Model) Predictions to General Dynamics Transmittance Measurements[26] for a Low Altitude 11.9 km Slant Path.

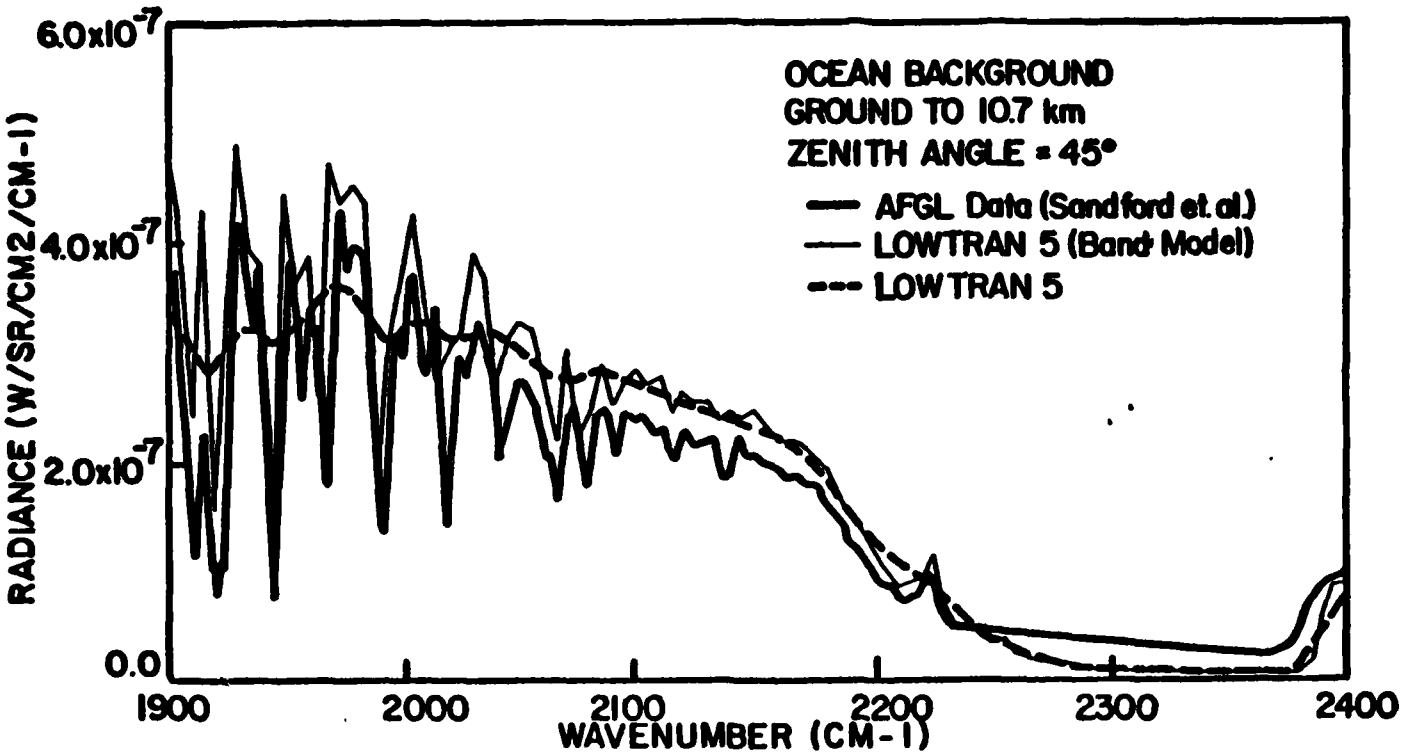

Figure 19. Comparison of LOWTRAN5 (Band Model) and LOWTRAN5 Predictions to AFGL Ocean Background Radiance Measurements.

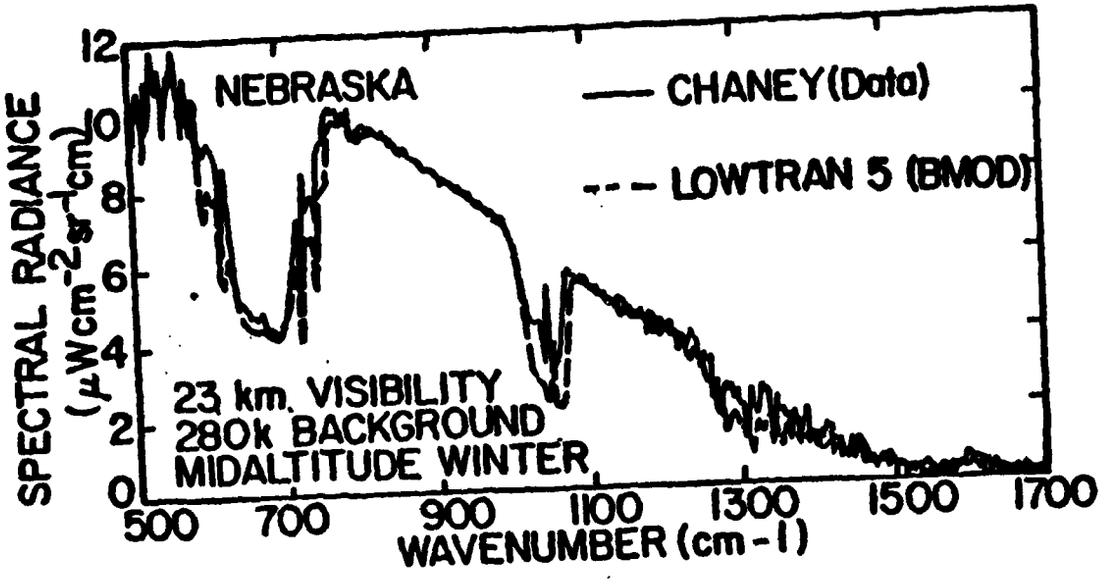

Figure 20. Comparison of LOWTRAN5 (Band Model) Predictions to University of Michigan Balloon Measurements of Background Radiance over Northern Nebraska.

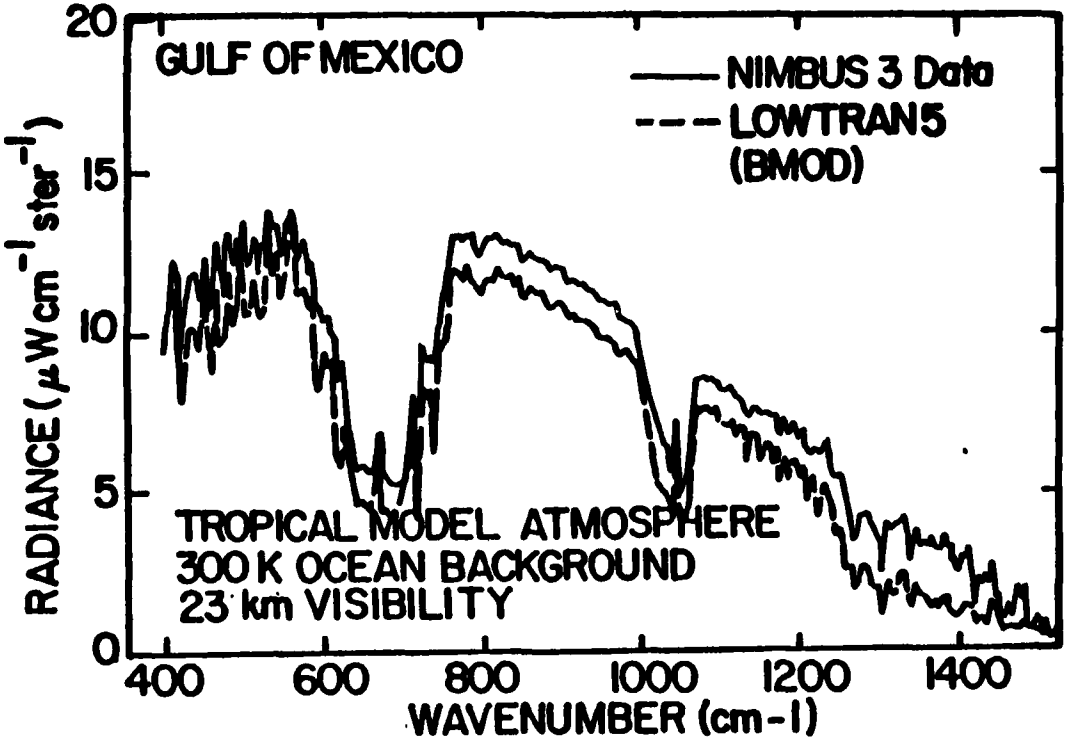

Figure 21. Comparison of LOWTRAN5 (Band Model) Prediction NIMBOS 3 Satellite Measurements of Background Radiance Over the Gulf of Mexico.

3. MODIFICATIONS TO LOWTRAN5

The coding modifications to LOWTRAN5 fall into two general categories. The first category, which is discussed in subsection 3.1 and 3.2, covers changes required to implement the BMOD option (5 cm^{-1} spectral resolution). The second category is optional changes which, although not required for the BMOD option, do serve to increase the code's overall capabilities. The optional changes discussed in subsection 3.3 include:

- The Print/Plot Package for plots and use of a slit function
- A blackbody source term at any H2 for radiation calculations
- Formatted READ and WRITE statements for general machine compatibility
- I/O device numbers in common blocks to facilitate device assignments
- LOWTRAN5 data in a BLKDATA subroutine for general machine compatibility
- LOWTRAN5 File 7 commented out because of the Print/Plot Package.

The required changes are indicated in the program listing by an asterisk before the sequence number; the optional changes are indicated by a colon. The required and non-required changes are guided by the philosophy that the impact on the LOWTRAN5 coding be minimized.

3.1 Implementation of the 5 cm^{-1} Capability

A new control parameter (JBMOD) on Card 1 selects a spectral resolution of 5 or 20 cm^{-1}. When using the BMOD option, an external tape or disc file containing the band model parameters in binary format is required for program execution.

Several changes have been made to the LOWTRAN5 common blocks. The new input parameter JBMOD has been added to common /CARD1/, because it is one of the input parameters on Card 1. Additionally, a new common block, /CARD4/, has been added to the main program LOWEM and to subroutines BMDATA and LIB. These subroutines need to know whether an additional LOWTRAN case is being calculated. The common block, /BMDCOM/, is shared by BMDATA and BMOD. It contains variables used in the band model calculations. Additionally, the pressure, PRES(68), has been added to blank common.

Several modifications were necessary in the calculation of the absorber amounts for H_2O, the UMIX gases and O_3. In LOWTRAN, the equivalent horizontal path parameters (EH), which are defined as the equivalent absorber density for a 1 km horizontal path at each altitude, are defined as the product of the actual absorber densities and an empirical scaling law which approximates the effects of altitude on the curve-of-growth. Since BMOD uses the unscaled absorber density for these species, they are calculated in subroutine HPROF and stored in the EH array in place of the scaled absorber densities. In a regular LOWTRAN5 calculation, the array WPATH(i) calculated in subroutine PATH stores the equivalent absorber density for the total path from the observer through the i'th layer. Since BMOD uses the Curtis-Godson approximation to calculate an equivalent optical depth, the incremental absorber density for the path through each layer is needed and is stored in WPATH. Additionally, the mean pressure for each layer is calculated in subroutine PATH and stored in blank common as PRES. It should be noted that the mean pressure and temperature of the layer in which H1 (or H2) fall is used by BMOD and not the mean pressure between H1 (or H2) and the layer boundary. This can lead to a small interpolation error in the band model coefficients but has little impact on the calculated transmittances.

The interface between the regular LOWTRAN5 and the BMOD option is made through subroutine calls made in subroutine TRANS. The one call to BMDATA reads the binary file header, skips over the wavenumber blocks to the first wavenumber of the calculation and calculates wavenumber-independent quantities. The calls to subroutine BMOD are made once for each wavenumber and then additionally in the loop

over atmospheric layers that calculates the molecular transmittance. On the first call, BMOD checks for the next read and sets up the calculation for the subsequent loop over layers; the atmospheric transmittance is calculated at 5 cm^{-1} spectral resolution in the second call. The approximately forty lines in TRANS, which calculate the H_2O, UMIX, and O_3 transmittance at 20 cm^{-1} resolution are skipped.

3.1.1 Subroutine BMDATA

Subroutine BMDATA is called once each calculation from line TRA *313 in TRANS. This subroutine makes the initial binary file read and calculates wavenumber-independent quantitites for subsequent use by subroutine BMOD.

After reading the file header BMDATA checks the wavenumber range requested by the user to see if it falls within the range in the file. If the requested interval is totally outside of the band model parameter range, the program stops with an error message. However, if the requested wavenumber interval is only partially outside of the allowed range, the program readjusts the upper and/or lower wavenumbers to the file's values and proceeds with the calculation. The next read skips over wavenumber blocks in the file until it reaches the wavenumber block containing V1, the initial wavenumber.

If the option IXY = 1 is used, the next calculation has the same atmospheric and path parameters but a new wavenumber range. In this case, the call to BMDATA only rewinds the file and performs the initial reads. The common block /CARD4/ was added to pass the value of IXY to BMDATA.

When using the BMOD option, the array WPATH contains the incremental optical depths for each layer. However, WPATH is not calculated by subroutine PATH when the path lies completely within one atmospheric layer, so it must be specified in subroutine BMDATA for use by subroutine BMOD. Next, the absorber densities (WPATH) are converted to the units of cm-amagats to be consistent with the units of the band model parameters. The absorber density conversion factors from the regular LOWTRAN5 units to those used in LOWTRAN5 (BMOD) are:

SPECIES	LOWTRAN5		LOWTRAN5 (BMOD)
H_2O	1 gm/cm^2	=	1.25 x 10^3 cm amagat
Umix Gases	1 km	=	1.0 x 10^5 cm amagat
O_3	1 cm amagat	=	1 cm amagat

where 1 amagat = 1 atm at STP. Finally, several wavenumber independent quantities for each layer are calculated in BMDATA and stored in the appropriate arrays for later use by BMOD. These are, $\sqrt{T}$, the pressure normalized to one atmosphere (P/P_o), and the temperature indices for interpolation of the band model parameters.

3.1.2 Subroutine BMOD

Subroutine BMOD calculates the transmittance using the statistical band model described in subsection 2.1. Its initial call is made once every wavenumber from TRANS (line TRA*1283), and subsequent calls are made for each layer to calculate the transmittance from line TRA*1394. On the first call BMOD checks to see if the next block of band model parameters needs to be read (IW is the counting variable) and then zeros out quantities for the transmittance calculations. On the subsequent call(s), BMOD calculates the total optical depth and transmittance for each species. The continuum contribution due to tails of H_2O and CO_2 lines originating outside the 5 cm^{-1} interval are included in the calculation. BMOD returns the transmittance for each species and required path to TRANS. The transmittances are stored in the regular LOWTRAN5 transmittance array (TX).

The call(s) made by TRANS to BMOD for calculating the transmittance is imbedded in a loop over atmospheric layers. When only transmittance is calculated, this DO-loop in TRANS consists of one pass. When atmospheric radiation is calculated, the TRANS loop is over all layers, because the radiation depends on the incremental change in transmittance for each layer. The Curtis-Godson approximation for the statistical band model also requires

the contribution from each layer for transmittance calculations. In keeping with the philosophy of minimizing changes to the basic LOWTRAN5 program, this layer loop is done in BMOD for transmittance-only calculations and in TRANS for radiation calculations. Thus, the layer loop in BMOD consists of just one pass when TRANS is looping over all layers and vice-versa. Subroutine BMOD determines whether the loop in TRANS is over one layer or all layers and then adjusts its own loop variable accordingly (line BMO 570).

The curve-of-growth used in the statistical model is based on the equivalent width of a single average line in an interval. The equivalent width is calculated by subroutine EWIDTH using a Voigt lineshape to combine the Doppler and Lorentz lineshapes. The Curtis-Godson approximation is used to calculate the Lorentz halfwidth (S1), Doppler halfwidth (S2) and line density (S3) for the equivalent homogeneous path (see Eqs. (8) and (9)). The effective number of lines is calculated from Eq. (11).

In addition to the molecular contributions from lines within each 5 cm^{-1} spectral interval, contributions from tails of H_2O and CO_2 lines external to that interval are also included. Since these tails have a smooth spectral structure, they form a continuum component, and Eq. (12) is used to calculate the transmittance. Only the CO_2 tails are considered in the UMIX gases. The tail contributions and the molecular components are combined (multiplied together) and stored in the matrix TX. These values for the transmittance are then used by subroutine TRANS in its calculation of the total atmospheric transmittance and radiation.

3.1.3 Subroutine CALC

CALC is called by subroutine BMOD (line BMO 720) to determine the band model parameters for arbitrary temperatures. The tabulated band model parameters are linearly interpolated over temperature for each layer. If the atmospheric temperature is outside of the temperature range of the tabulated parameters, the entry for either the lowest or highest temperature is returned.

3.1.4 Subroutine EWIDTH

EWIDTH is called by subroutine BMOD (line BMO 980) to calculate the equivalent width of a single average line for the 5 cm^{-1} interval. As discussed in subsection 2.1, the Voigt lineshape is numerically integrated over the full interval using Eqs. (4) to (7). When the optical depth at the line center is less than XMIN/π Beer's law is used. Otherwise EWIDTH compares the relative values of the Doppler and Lorentz halfwidths and selects the proper formula for the numerical integration.

Several numerical approximations are used in calculating the equivalent width. Equation (4b) is the real part of the complex error function[18] and is calculated in subroutine CPF12. The region out to three halfwidths is calculated by using a linear approximation for Eq. (4) in the integration interval. From a study of various combinations for the number of integration intervals for each halfwidth (ISTEP) and the number of halfwidths from the line center (NALF), integrating out to three halfwidths in six steps was found to represent a reasonable trade-off between numerical accuracy and execution time. The region beyond three halfwidths of the line center is calculated using Eq. (6).

3.1.5 Subroutine ERFU

ERFU is used by EWIDTH (line EWI 760) to calculate the error function as part of the evaluation of Eq. (6). A polynomial approximation which is accurate to better than 2.5×10^{-5} is used.[18]

3.1.6 Subroutine CPF12

CPF12 is called by EWIDTH (line EWI 560) to calculate the complex error function[18] and its first derivative. The real part is identical to Eq. (4b), and the first derivative is used to approximate its frequency dependence when performing the integration of Eq. (4a). The complex error function subroutine,

which was developed by J. Humlicek,[19] is based on a 12'th order Hermite polynomial approximation. We investigated using only an 8'th order approximation, but the results were not sufficiently accurate.

3.2 Data Tape for the Band Model Parameters

The tabulated band model parameters are stored in an external file. The file has approximately 23,000 entries. It contains the S/d and 1/d parameters for five temperatures plus the average linewidth and molecular weight for each species at 5 cm^{-1} increments. The four species stored in the file are H_2O, the UMIX gases, O_3, and the H_2O and CO_2 line wings. The data for the four species are blocked in 100 cm^{-1} increments (20 wavenumber points) for the wavenumber range from 400 cm^{-1} to 9990 cm^{-1}. The tape is delivered with the data written in formatted form (120 characters/line). However, a binary file is expected by LOWTRAN5 because of the significant difference in the execution speed. Conversion of the formatted file to binary format on the user's system is discussed further in Appendix F, and a sample program listing is in Appendix G.

3.3 Optional Changes

The optional changes to the coding are modifications which either increase the code's usefulness or make it more compatible with other computers (e.g., CDC, UNIVAC, DEC, IBM, Honeywell, etc.). These changes are indicated by a colon and can easily be ignored by the user. If the user wishes to just implement the BMOD option on his already operational version of LOWTRAN5, only the BMDATA, BMOD, CALC, EWIDTH, ERFU, and CPF2 subroutines need to be added (though this procedure is not recommended). Making the changes indicated by asterisks in the program and preparing the binary tape will complete the implementation. The optional changes in this version of LOWTRAN5 and their motivation are described below.

3.3.1 Slit Function and Plotting Package

The Print/Plot Package was developed at Aerodyne Research, Inc. for use with the LOWTRAN5 computer code on its PRIME 400 system. A detailed description is given in Appendix A; the input parameters are described in Section 4.

The slit function allows the user to degrade the 5 cm^{-1} calculations to a lower spectral resolution. The slit function is defined by specifying the weighting factors for up to eight wavenumber points. The routine is self-normalizing so the user can specify arbitrary values for the weights and wavenumber increments. The results are presented in tabular form with each transmittance or radiation value being printed twice. The first tabulation has two significant figures for a quick scan of the results, and the second one contains five significant figures.*

The plot package allows the user to plot results as part of the calculation. As a minimum the user only needs to specify the title and the dimensions of the plots. However, he can specify other parameters such as the wavenumber interval and the interval at which the transmittance or radiation are presented. Usually the print/plot package will make its own selection. The MODEL = 10 option can be used to obtain multiple plots from the same calculation. For example, when using a slit function the degraded results can be calculated and plotted after the undegraded results are plotted.

3.3.2 Blackbody Source Term at H2

A blackbody radiation source at H2 is always included in LOWTRAN5 for look-down paths when H2 falls within the first layer. The optional change allows a blackbody source term to be included for arbitrary H2. Radiation calculations with no source term are obtained by specifying IEMISS = 1 (for the radiation calculation) and zero or a negative temperature for TBOUND (to remove the source term).

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*This does not imply that the calculated results have this accuracy.

3.3.3 Generalized READ and WRITE Statements

The READ and PRINT statements were generalized to provide a version that can be easily implemented on the lartest number of FORTRAN compilers. The unformatted PRINT statements were changed to WRITE statements with the addition of the logical unit associated with input. The READ statements that did not reference FORTRAN logical units were modified to include the unit number. Unit numbers are indicated by integer variables so that their assignments may easily be changed.

3.3.4 FORTRAN Logical Unit and File Assignments

Integer variables are used throughout this version of LOWTRAN5 for the FORTRAN logical units (FLUs) in all program I/O. This aids in implementing the code in facilities that have different FLUs default values for particular devices. Table 2 displays the variable names for the FLUs, where the variable names are assigned their values, and the value and file type associated with each variable. Changing the indicated line in the progrm is all that is necessary to change the FLU assignment. The COMMON blocks DEVNUM and PLTDEV are used to communicate the FLUs from program module to program module.

NIN, NOUT and NSTOR (FLUs 5, 6 and 7, respectively) have their same meaning as in the original version of LOWTRAN5. All other FLUs have been added to this version. NPLT contains the same transmittance and radiance values that are written to NSTOR, but in binary. The file associated with NPLT is used as input to the Print/Plot Package. NTBL is associated with the input binary file that contains the band model parameters. This file is read by subroutines BMOD and BMDATA. NSCR is associated with a scratch file used by the Print/Plot Package to store and retrieve degraded spectra. NPLT is the FLU associated with the CALCOMP-type plotting device (if any) on the computer system.

TABLE 2 - FORTRAN LOGICAL UNIT (FLU) ASSIGNMENTS

VARIABLE NAME	ASSIGNED IN	DESCRIPTION	FLU ASSIGNMENT	FILE TYPE
NIN	LOW:1237	INPUT FILE	5	READ ONLY
NOUT	LOW:1238	PRINTED OUTPUT FILE	6	WRITE ONLY
NSTOR*	LOW:1239	SECONDARY OUTPUT FILE	7	WRITE ONLY
NPLT	LOW:123A	INFO FOR PRINT/PLOT PACKAGE	9	TEMPORARY READ/WRITE
NTBL	BMD 350	BINARY-BAND MODEL PARAMETERS	12	READ ONLY
NSCR	LIB 320	SCRATCH PAD FOR PLOTTING	11	TEMPORARY READ/WRITE
NPLTR	LIB 460	CALCOMP-TYPE PLOT DEVICE	4	WRITE ONLY

*References to NSTOR have been commented out.

3.3.5 BLOCK DATA Restructure

The original version of LOWTRAN5 contained several named BLOCK DATA subprograms. Some of the DATA statements in the BLOCK DATA modules contain non-standard ANSI FORTRAN syntax. In an attempt to make this version of LOWTRAN5 more universal, the BLOCK DATA structure was changed.

All the named BLOCK DATA subprograms were concentrated into one un-named BLOCK DATA routine. The commons for storing the C1, C2 and C3 data were removed as these data are only used in one subroutine, C1DTA, C2DTA, C3DTA, respectively.

Any DATA statements with "implied-do loop" syntax were changed into a standard syntax. In order to keep the number of continuation cards to less than twenty, some arrays were added and placed in EQUIVALENCE with the larger LOWTRAN5 arrays in the DATA statements.

4. INPUT INSTRUCTIONS

The first four data cards are identical to those for LOWTRAN5 with the exception of the addition of JBMOD to Card 1. The second group of cards specifies the parameters for the optional Print/Plot Package. The input parameters are given in Table 3. For completeness, the regular LOWTRAN5 input cards are summarized in subsection 4.1. More detailed information can be found in the LOWTRAN5 User's Manual.[1] Instructions for specifying the Print/Plot parameters are given in subsection 4.2.

TABLE 3 - LOWTRAN5 INPUT DATA

CARD NUMBER	PARAMETERS	FORMAT
1	MODEL, IHAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, RO, TBOUND, ISEASN, IVULCN, VIS, JBMOD	11I3, 2F10.3, 2I3, F11.3, I2
1A	(IF MODEL = 7 AND IM = 1) Z, P, T, DP, RH, WH, WO, AHAZE, VIS1, IHA1, ISEA1, IVUL1	3F10.3, 2F5.1, 3E10.3, F7.3, 3I1
2	H1, H2, ANGLE, RANGE, BETA	7F10.3
2'	(REPLACES CARD 2 WHEN MODEL =0) H1, P, T, DP, RH, WH, WO, RANGE	3F10.3, 2F5.1, 2E10.3, F10.3
3	V1, V2, DV	7F10.3
4	IXY	I3
5	TITLE	20A4
6	MSLT, MPRT, MPLT, NS, WIDTH, SHIFT	4I2, 2X, 2F10.0
7A 7B	(SLIT FUNCTION PARAMETERS) XSS(I), I = 1, NS SS(I), I = 1, NS	8F10.5 8F10.5
8A 8B	(PLOTTING PARAMETERS) XAXIS, XINT, XEND, DXT, NMINX YAXIS, YINT, YEND, DYT, NMINY	4E10.4, I10 4E10.4, I10

4.1 LOWTRAN5 Input Parameters

The instructions and user options given here are the same as the regular LOWTRAN5 code excepting some changes to Card 1. The changes are the MODEL = 10 option, use of a blackbody source for arbitrary H2, and the JBMOD option. The user is directed to the LOWTRAN5 User's Manual[1] for further explanation, especially for the aerosol models.

CARD 1: MODEL, IHAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, RO, TBOUND, ISEASN, IVULCN, VIS, JBMOD

(Format 11I3, 2F10.3, 2I3, F11.3, I2)

MODEL	= 0	Meteorological data for a horizontal path (Card 2' follows)
	= 1	Tropical atmosphere
	= 2	Midlatitude summer
	= 3	Midlatitude winter
	= 4	Subarctic summer
	= 5	Subarctic winter
	= 6	1962 U.S. Standard
	= 7	User specified atmospheric profile
	= 10	Skip to plot package (Card 4 follows).

IHAZE	= 0	No aerosol attenuation
	= 1	Rural model, 23 km visibility
	= 2	Rural model, 5 km visibility
	= 3	Maritime model, 23 km visibility
	= 4	Maritime model, 5 km visibility
	= 5	Urban model, 5 km visibility
	= 6	Tropospheric model, 50 km visibility
	= 7	User-defined extinction model
	= 8	FOG1 (advection fog), 0.2 km visibility
	= 9	FOG2 (radiation fog), 0.5 km visibility

ITYPE	=	1	Horizontal (constant-pressure) path
	=	2	Slant path from H2 (source) to H1 (observer)
	=	3	Slant path from space (source) to H1 (observer)
LEN	=	0	Normal operation
	=	1	Selects the long downward path when 0 < HMIN < H2
JP	=	0	Normal operation
	=	1	Suppress printed output
IM	=	0	Subsequent calculations to be run with MODEL = 7
	=	1	Radiosonde data to be read in initially
M1	=	0	Normal operation
	=	1-6	Selects temperature and pressure altitude profile from the appropriate model atmosphere
M2	=	0	Normal operation
	=	1-6	Selects corresponding water vapor model profile
M3	=	0	Normal operation
	=	1-6	Selects corresponding ozone model profile
ML	=	0	Normal operation
	≠	0	Number of user-specified levels (when IM = 1)
IEMISS	=	0	Transmittance only
	=	1	Transmittance and radiation calculated
RO	=	0	Earth radius appropriate to model atmosphere (If MODEL = 0 or 7, the midlatitude value of 6371.23 km is used)
	≠	0	User-specified value

TBOUND	>	0	Blackbody temperature of source at H2
	≤	0	No blackbody source at H2 (only atmospheric radiance is calculated)
ISEASN	=	0	Season determined from value of MODEL Spring-Summer for MODEL = 0,1,2,4,6,7 Fall-Winter for MODEL = 3,5
	=	1	Spring-Summer
	=	2	Fall-Winter
IVULCN	=	0,1	Background stratospheric profile and extinction
	=	2	Moderate volcanic profile and aged volcanic extinction
	=	3	High volcanic profile and fresh volcanic extinction
	=	4	High volcanic profile and aged volcanic extinction
	=	5	Moderate volcanic profile and fresh volcanic extinction
VIS	≠	0	Visibility range (km)
	=	0	Default value set by IHAZE
JBMOD	=	0	Regular LOWTRAN5
	=	1	5 cm^{-1} BMOD option

CARD(S) 1A: (Insert when MODEL = 7)

Z, P, T, DP, RH, WH, WO, AHAZE, VIS1, IHA1, ISEA1, IVUL1

(Format 3F10.3, 2F5.1, 3E10.1, F7.3, 3I1)

Z	=	Altitude (km)
P	=	Pressure (mb)
T	=	Ambient temperature (^{o}C)

DP = Dew-point temperature (^{o}C)

RH = Relative humidity (%)

WH = Water vapor density (gm m^{-3})

WO = Ozone density (gm m^{-3})

AHAZE = Aerosol number density (normalized by the user to the required meteorological range using the LOWTRAN extinction coefficients)

VIS1 = Meteorological range (km) for the altitude, Z

IHA1 = Aerosol extinction and meteorological range control for the altitude, Z

ISEA1 = Aerosol season control for the altitude, Z

IVUL1 = Aerosol profile and extinction control for the altitude, Z

CARD 2: H1, H2, ANGLE, RANGE, BETA
(Format 7F10.3)

H1 = Altitude of observer

H2 = Altitude of path start (source altitude in radiation calculations)

ANGLE = Initial zenith angle measured from H1 (degrees)

RANGE = Path length (km)

BETA = Earth center angle subtended by H1 and H2

CARD 2': (Replaces Card 2 when MODEL = 0)

H1, P, T, DP, RH, WH, WO, RANGE

(Format 3F10.3, 2F5.1, 2E10.3, F10.3)

HI = Altitude of horizontal, constant-pressure path

P,T,DP,RH, WH,WO = Defined under Card(s) 1A

RANGE = Path length (km)

CARD 3: V1, V2, DV

(Format 7F10.3)

V1 = Initial wavenumber (cm^{-1})

V2 = Final wavenumber (cm^{-1})

DV = Wavenumber increment (cm^{-1})
(must be 5 cm^{-1} when JBMOD = 1)

CARD 4: IXY (Format I3)

IXY = 0 End of calculation
= 1 Only select new Cards 3 and 4-8
= 2 Select new data sequence
= 3 Only select new Cards 2 and 4-8
= 4 Only select new Cards 1 and 4-8

The new data cards specified by IXY are read after the Print/Plot control cards (Cards 5-8).

4.2 Print/Plot Parameters

The second group of input cards determines the options for the Print/Plot Package. The LOWTRAN transmittance and radiation calculations are written to an external file (NPLT) which is rewound and read by this output section. Multiple calls which allow specification of different output formats for the same calculation are obtained by repeating the calculation (IXY = 2 or 4) and then setting MODEL = 10 on Card 1. In this case, the transmittance calculations are skipped, and the previous results can be printed and/or plotted in a different format (e.g., vs wavenumber and then vs wavelength). The general sequence for the output control cards is as follows:

Card 5	TITLE
Card 6	Print/Plot Control Parameters
Cards 7A,B	Slit Function Parameters
Cards 8A,B	Plotting Parameters

The output subroutines are executed in one call to subroutine LIB, which is made just after reading Card 4 of the regular LOWTRAN5 input data sequence.

CARD 5: TITLE
(Format 20A4)
This title is printed on the plots and tabulated output.

CARD 6: MSLT, MPRT, MPLT, WIDTH, SHIFT
(Format 4I2, 2X, 2F10.0)

MSLT = 0 Repeat the previous case with no change in parameters; (cannot have MSLT = 0 on the first case)

= 1 Use the calculated results directly

= 2 Degrade using the slit function

MPRT = 0 Do not print any results

= 1 Print transmittance only

= 2 Print radiation only

= 3 Print transmittance and radiation

MPLT = 0 Skip plots

= (1,-1) Plot transmittance vs (cm^{-1}, μm)

= (2,-2) Plot radiance vs (cm^{-1}, μm)

= (3,-3) Plot transmittance and radiance vs (cm^{-1}, μm)

NS = Number of (XSS, SS) points to define the slit function (max. 8)

WIDTH = Total width of the slit function base in cm^{-1}

SHIFT = Shift (cm^{-1}) in the midpoint of the slit function for the next calculational point in degrading the spectrum

If MSLT = 0, the Print/Plot parameters are used from the previous case; then the other parameters on Card 6 are zero, and Cards 7 and 8 are skipped. If no slit function is desired (MSLT = 1) or if the previously specified slit function is repeated (MSLT = 0), Cards 7A and 7B are omitted. MPLT is the control variable which governs the number and type of plots.

CARD 7A: XSS(I), (I = 1, NS) (Format 8F10.5)

CARD 7B: SS(I), (I = 1, NS) (Format 8F10.5)

XSS = Wavenumber coordinates of slit function points

SS = Values of the weighting function at the XSS points

An example of a generalized slit function is given in Fig. 22 for an arbitrary set of XSS and SS values. The results which have been calculated at the resolution specified by DV (5 cm^{-1} for the BMOD option!) are degraded by integrating over the slit function. Interpolation between the user-specified points is linear. High order polynomial interpolations can be used by changing the value of the parameter NDEG in Subroutine GEN. The slit function is self normalizing, so arbitrary values of SS and XSS can be used. That is, the span of the slit coordinate points, $|XSS_{max} - XSS_{min}|$, is normalized to WIDTH, and the area of the weighting function points over XSS is normalized to unity. For example, a triangular slit function, which has a spectral resolution of 40 cm^{-1} (FWHM) and, whose spectrum is calculated in increments of 10 cm^{-1}, is given by:

NS = 3 XSS = -1.0, 0.0, 1.0
WIDTH = 80. SS = 0.0, 1.0, 0.0
SHIFT = 10.

CARD 8A: XAXIS, XINIT, XEND, DXT, NMINX (Format 4E10.4, I10)

CARD 8B: YAXIS, YINIT, YEND, DYT, NMINY (Format 4E10.4, I10)

(XAXIS, YAXIS) = Length of (x-axis, y-axis) in inches

(XINIT, YINIT) = Value of (x,y) at the origin (optional)

(XEND, YEND) = Upper limits of (x,y) (optional)

XSS	SS
-1.0	0.
0.0	1.
+1.0	0.

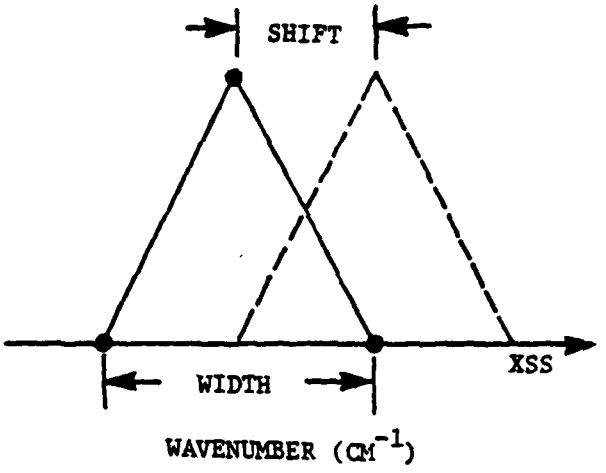


Figure 22. Example of the Generalized Slit Function for a Simple Triangular Slit. The Values of XSS and SS are Tabulated.

(DXT, DYT) = (x,y) units between major tic marks (optional)

(NMINX, NMINY) = Number of minor tic marks between the major ones (optional)

Except for XAXIS and YAXIS, which determine the physical dimensions of the graph, the plotting variables need not be specified. The default values are determined internally. For example, the default values of XINIT and XEND are V1 and V2.

5. REFERENCES

1. F.X. Kneizys, E.P. Shettle, W.O. Gallery, J.H. Chetwynd, Jr., L.W. Abreu, J.E.A. Selby, R.W. Fenn, and R.A. McClatchey, Atmospheric Transmittance/ Radiance: Computer Code LOWTRAN 5, AFGL-TR-80-0067, February 1980, Air Force Geophysics Laboratory, Bedford, MA.

2. J.E.A. Selby, F.X. Kneizys, J.H. Chetwynd, Jr., and R.A. McClatchey, Atmospheric Transmittance/Radiance: Computer Code LOWTRAN4, AFGL-TR-78-0053, AD A058 643, (1978), Air Force Geophysics Laboratory, Bedford, MA.

3. J.E.A. Selby, E.P. Shettle, and R.A. McClatchey, Atmospheric Transmittance from 0.25 to 28.5 μm: Supplement LOWTRAN 3B, AFGL-TR-76-0258, AD A040 701, (1976), Air Force Geophysics Laboratory, Bedford, MA.

4. J.E.A. Selby and R.A. McClatchey, Atmospheric Transmittance from 0.25 to 28.5 μm: Computer Code LOWTRAN 3, AFCRL-TR-75-0255, AD A017 734, (1975), Air Force Geophysics Laboratory, Bedford, MA.

5. J.E.A. Selby and R.A. McClatchey, Atmospheric Transmittance from 0.25 to 28.5 μm: Computer Code LOWTRAN 2, AFCRL-TR-72-0745, AD 763 721, (1972), Air Force Geophysics Laboratory, Bedford, MA.

6. D. Anding, Band Model Methods for Computing Atmospheric Slant-Path Molecular Absorption, Rpt. No. 7142-12-T, Willow Run Laboratories, Institute of Science and Technology, University of Michigan, Ann Arbor, MI, 1967.

7. A.J. LaRocca and R.E. Turner, Atmospheric Transmittance and Radiance: Methods of Calculation, Rpt. No. 107600-10-T, Environmental Research Institute of Michigan, Ann Arbor, MI, June 1975.

8. T. Aoki, J. Quant. Spectrosc. Radiat. Transfer, 24, 191 (1980).

9. R.R. Gruenzel, Appl. Opt., 17, 2591 (1978).

10. J.H. Pierluissi, K. Tomiyama, and R.B. Gomez, Appl. Opt., 18, 1607 (1979).

11. R.A. McClatchey, W.S. Benedict, S.A. Clough, D.E. Burch, R.F. Calfee, K. Fox, L.S. Rothman, and J.S. Garing, AFCRL Atmospheric Absorption Line Parameters Compilation, AFCRL-TR-73-0096, January 1973, Air Force Geophysics Laboratory, Bedford, MA.

12. A.R. Curtis, Quart. J. Roy. Meteorol. Soc., 78, (1952).

13. W.L. Godson, J. Meteorol., 12, (1955).

14. G.N. Plass, J. Opt. Soc. Am., 48, 690 (1958).

15. R.M. Goody, Quart. J. Roy. Meteorol. Soc., 78, 165 (1952).

16. H. Mayer, Methods of Opacity Calculations, Los Alamos, LA-647, October 31, 1947.

17. C.B. Ludwig, W. Malkmus, J.E. Reardon, and J.A.L. Thomson, Handbook of Infrared Radiation from Combustion Gases, NASA Rpt. No. SP-3080, 1973.

18. M. Abramowitz and I.A. Stegun, Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables, NBS Applied Mathematics Series - 55, December 1965.

19. J. Humlicek, J. Quant. Spectrosc. Radiat. Transfer, 21, 309 (1978).

20. D.E. Burch, D.A. Gryvnak, R.R. Patty, and G.E. Bartky, J. Opt. Soc. Am., 59, 267 (1969).

21. D.E. Burch, Semi-Annual Technical Report Investigation of the Absorption of Infrared Radiation by Atmospheric Gases, Aeronutronic Rpt. U-4784, Contract F19628-69-C-0263, Philco-Ford Corp., Newport Beach, CA, 15 May 1969.

22. D.E. Burch and D.A. Gryvnak, Final Technical Report - Absorption by CO_2 Between 2400 and 3450 cm^{-1}, Aeronutronic Rpt. U-4910, contract 952672, Philco-Ford Corp., Newport Beach, CA, February 1971.

23. J. Susskind and J.E. Searl, J. Quant. Spectrosc. Radiat. Transfer, 19, 195 (1978).

24. J. Susskind and J.E. Searl, J. Quant. Spectrosc. Radiat. Transfer, 18, 581 (1977).

25. L.S. Bernstein, D.C. Robertson, J.A. Conant, and B.P. Sandford, Appl. Opt., 18, 2454 (1979).

26. D. Blay, General Dynamics (Private Communication).

27. B. Sandford, Air Force Geophysics Laboratory, Bedford, MA (Private Communication).

28. L.W. Chaney, An Experimental Fourier Transform Asymmetrical Interferometer for Atmospheric Radiation Measurements, 1969, University of Michigan Technical Rpt. 05863-18-T.

29. B.J. Conrath, R.A. Hanel, V.G. Kunde, and C. Prabhakara, The Infrared Interferometer Experiment on Nimbus 3, 1970, Goddard Space Flight Center, Greenbelt, MD, Rpt. X-620-70-213.

APPENDIX A

LOWTRAN5 PRINT/PLOT PACKAGE

A.1 INTRODUCTION

In addition to the 5 cm^{-1} option, a Print/Plot Package is included with this version of LOWTRAN5. Since its only interface with the main program is through one call statement in the main program and four writes to FLU NPLT by subroutine TRANS, the user has the option whether or not to use this additional capability with no impact on the rest of the program.

The Print/Plot Package expands the output capabilities of the code to allow the user to:

- Spectrally degrade the results using a user-specified slit function; and
- Tabulate the calculated transmittance and/or radiation as a function of wavenumber or wavelength; and
- Generate plots on the user's plotter.

By using the MODEL = 10 option, multiple calls to the Print/Plot Package through subroutine LIB can be made so that the results from a single calculation can be presented in different formats (undegraded and degraded spectra, plots vs. wavenumber and vs. wavelength, etc.).

The Print/Plot Package consists of the subroutines listed in Table A.1. The first six subroutines are part of the LOWTRAN5 program, and the second eight are calls to the plotter. The second group (or a suitable modification thereof) must be furnished by the user's facility as part of its plotting library. The plotter subroutines which the Print/Plot Package expects the user to provide are described in Section A.2.

TABLE A.1 - PRINT/PLOT SUBROUTINES

NAME	ARGUMENTS	FUNCTION
LOWTRAN5 SUBROUTINES (PRINT/PLOT PACKAGE)		
LIB	MSLTO, LPLT	CALLS SLIT FUNCTION SETS UP OUTPUT AND PLOTS
ALL	---	PRINTS/PLOTS UNDEGRADED SPECTRUM
GEN	WIDTH,SHIFT,XSS,SS,NS	CALCULATES SLIT FUNCTION
PROUT	---	PRINTS OUTPUT AND PLOTS CURVES
WRTDAT	N,X,Y	SETS UP DATA FOR PROUT
TERP	XC,X,Y,NDEG,NPTS,IER	PERFORMS NEWTON'S INTERPOLATION FOR DISCRETE DATA POINTS
PLOTTER SUBROUTINES (USER'S INSTALLATION)		
PLOT	X,Y,IPEN	PLOTS A VECTOR/MOVES PEN
SYMBOL	X,Y,HITE,ARRAY,THETA,NCHARS	PLOTS VECTORED SYMBOLS
NUMBER	X,Y,HITE,RNUM,THETA,NDEC	PLOTS REAL NUMBER
LINE	XARRAY,YARRAY,NPTS,INC,LINCTL, ISYM	PLOTS LINE FROM SCALED ARRAYS
AXIS	X,Y,TITLE,NCHARS,AXLEN,THETA, RLEAST,DELTAV,DELTAT,NMIN	PLOTS A LABELED AXIS
INITP$	IPDEV,IEDEV	INITIALIZES PLOT PACKAGE
ENDPLT	---	TERMINATES PLOTTING
WHERE	X,Y,FAC	GIVES PEN COORDINATES

TABLE A.2 - LOCATION OF CALLS TO EXTERNAL PLOTTER

SUBROUTINE NAME	CALLING LOCATION	FUNCTION
INITP$	LIB 910	INITIAL CALL TO THE PLOTTER
PLOT	LIB 920	MOVES PEN TO THE ORIGIN
PLOT	LIB 1280	RESETS ORIGIN FOR NEXT PLOT
ENDPLT	LIB 1340	CLOSE PLOTTING FILES BEFORE STOPPING
AXIS	PRO 730	DRAW X-AXIS
AXIS	PRO 740	DRAW SCALE ON TOP AND PRINT TITLE
AXIS	PRO 750	DRAW Y-AXIS
AXIS	PRO 760	DRAW SCALE ON RIGHT-HAND SIDE
SYMBOL	PRO 780	PRINTS NORMALIZATION LABEL (IF PLOT IS RENORMALIZED)
WHERE	PRO 790	LOCATE PEN
NUMBER	PRO 810	WRITE EXPONENT OF RENORMALIZATION
WHERE	PRO 820	LOCATE PEN
SYMBOL	PRO 830	PRINT LABEL
LINE	PRO 1140	PLOT LINE

A.2 PLOTTER SUBROUTINES

The plotter library used at Aerodyne Research, Inc. is a modification of DIPLOT. Prime DIPLOT (Device Independent PLOT Package) is designed to allow the user to direct his plotter output to the plotter, using the industry accepted Calcomp calling sequences.

SUBROUTINE CALLING SEQUENCES

The FORTRAN subroutines used in the Print/Plot Package for LOWTRAN5 are described below. All linear arguments are in inches.

Subroutine PLOT - Basic Pen Movement Control

The PLOT subroutine allows the user to draw a vector or move the pen from one point to another. Optionally, the origin may be reset to the given X and Y coordinates, depending on the value of the pen control variable (IPEN).

Calling Sequence:

CALL PLOT (x,y,ipen)

x,y	The coordinates to which the pen is to be moved, relative to the current origin
ipen	The pen control variable, set as follows:

Value	Meaning
2	lower pen and move
3	raise pen and move
-2	lower pen, move, and reset origin to given x,y
-3	raise pen, move, and reset origin to given x,y

Subroutine SYMBOL - Plots Vectored Symbols

This subroutine will plot an ASCII character string as vectored symbols. The full ascii character set is supported, including the 26 lower case characters. Also, it is possible to plot one of the 10 centered symbols by setting ARRAY to the appropriate number (0-9) and setting NCHARS to -1 or -2.

Calling Sequence:

CALL SYMBOL (x,y,hite,array,theta,nchars)

x,y	The coordinates of the lower left-hand corner of the first character to be plotted, or the coordinates of the centered symbol if NCHARS is -1 or -2.
hite	Height of the characters to be plotted
array	ASCII array or special symbol code
theta	The angle of rotation
nchars	The number of characters to be plotted or, if a special symbol is to be plotted:

Value	Meaning
-1	raise pen before moving
-2	lower pen before moving, thus drawing a part of the line or curve

Subroutine NUMBER - Plots a Real Number

This routine will plot any real number to a user-specified number of decimal places. Leading zeroes and spaces are suppressed.

Calling Sequence:

CALL NUMBER (x,y,hite,rnum, theta,ndec)

x,y	Coordinates of the lower left-hand corner of the first digit to be plotted
hite	Height of the output string
rnum	The real number to be plotted
theta	The angle of rotation of the string
ndec	Number of decimal places to be plotted as follows:

Value	Meaning
>0	plot number to 'ndec' decimal places
0	plot no decimal places, but do plot a decimal point (.)
-1	plot integer part only

Subroutine LINE - Plots a Line from Two Arrays

This subroutine will plot a line from 2 scaled X and Y arrays. Optionally, the plotted line may consist of a line only, a line with centered symbols at user-specified intervals, or centered symbols only, depending on the line control variable (LINCTL). Note that this line has been scaled by subroutine PROUT, and the two extra elements are added to the end of the data array being plotted. The first element represents the first value for the plot range, and the second element represents the change in units per inch.

Calling Sequence:

CALL LINE (xarray,yarray,npts,inc,linctl,isym)

xarray,yarray	The two arrays used to plot the line; these may be scaled by SCALE before use by LINE
npts	Number of data points to be plotted
inc	The increment of the subscript for consecutive elements within the array
linctl	Line plotting control variable, set as follows:

Value	Meaning
0	line is drawn connecting points
<0	symbol is drawn at each IABS(linctl) 'th point; no line is drawn
>0	symbol is drawn at each (linctl)i'th point; a line is drawn connecting the points

isym	The number of the special symbol to be drawn, if any

Subroutine AXIS - Plots a Labeled Axis

This routine will plot a labeled axis with user-specified tic mark variations, labels, and length.

Calling Sequence:

CALL AXIS (x,y,title,nchars,axlen,theta,rleast,deltav,deltat,nmin)

x,y	The coordinates of the left-hand end of the axis
title	ASCII title of the axis

nchars	Number of characters in the title - if >0, tic marks, calibration, and title will appear on the counter-clockwise side of the axis; if <0, they will appear on the clockwise side of the axis; nchars should be <0 for X axis, >0 for Y axis
axlen	Length of axis
theta	Angle of rotation of axis, calibration, and title
rleast	The minimum value in the array - this may be name of the first extra element of the array returned by SCALE
deltav	The change in value of the array for each inch to be plotted - this may be the name of the second extra element of the array returned by SCALE
deltat	The change in value of the array between plotted tic marks
nmin	The number of minor (uncalibrated) tic marks between major ones

Subroutine WHERE - Returns Current Pen Position

The WHERE subroutine returns the current pen position in the two given variables, thus locating a "lost" pen. This is useful in determining pen position after a call to subroutine SYMBOL.

Calling Sequence:

CALL WHERE (x,y,fac)

x,y	The current scaled pen position relative to the origin
fac	Current factor

Subroutine INITP$ - Plot Initialization

This routine allows the program to specify the plot and error devices. The dimensions of the plotter bed are assumed to be internal so they are not specified in the call.

Calling Sequence:

CALL INITP$ (ipdev, iedev)

ipdev	Plot device number
iedev	Error device number

NOTE: This is not a standard Calcomp call. The appropriate initialization routine at the user's facility should replace this.

Subroutine ENDPLT - Plot Termination

This subroutine will dump any points in the buffer and close any plot or error files.

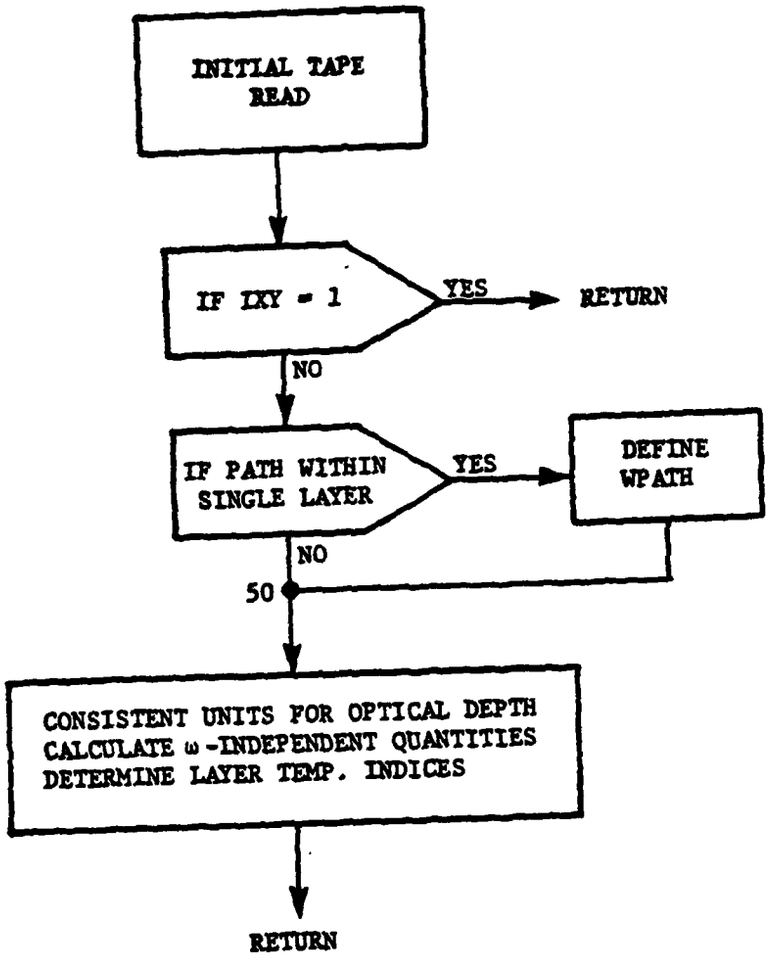
Calling Sequence:

CALL ENDPLT

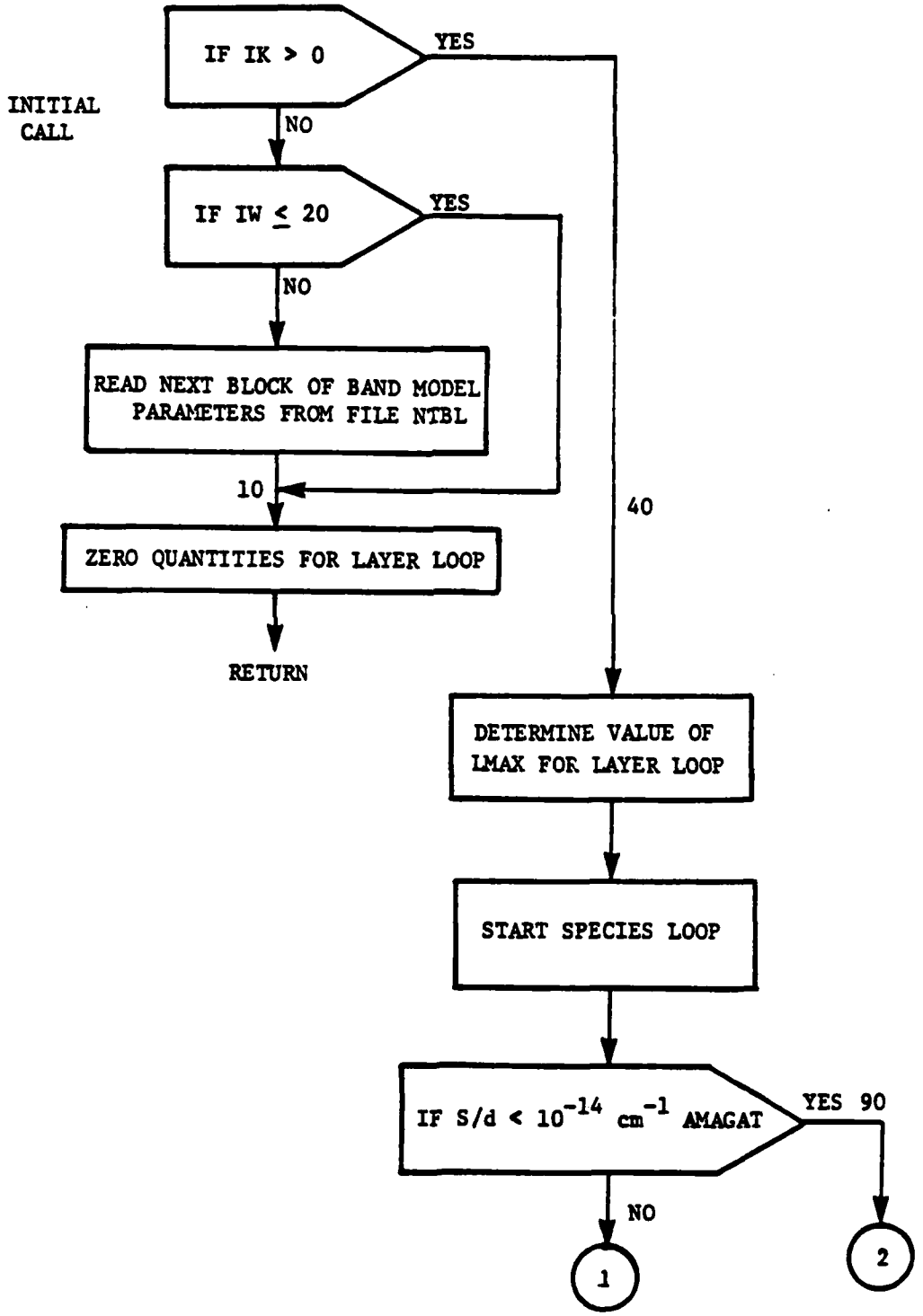
APPENDIX B

FLOWCHARTS

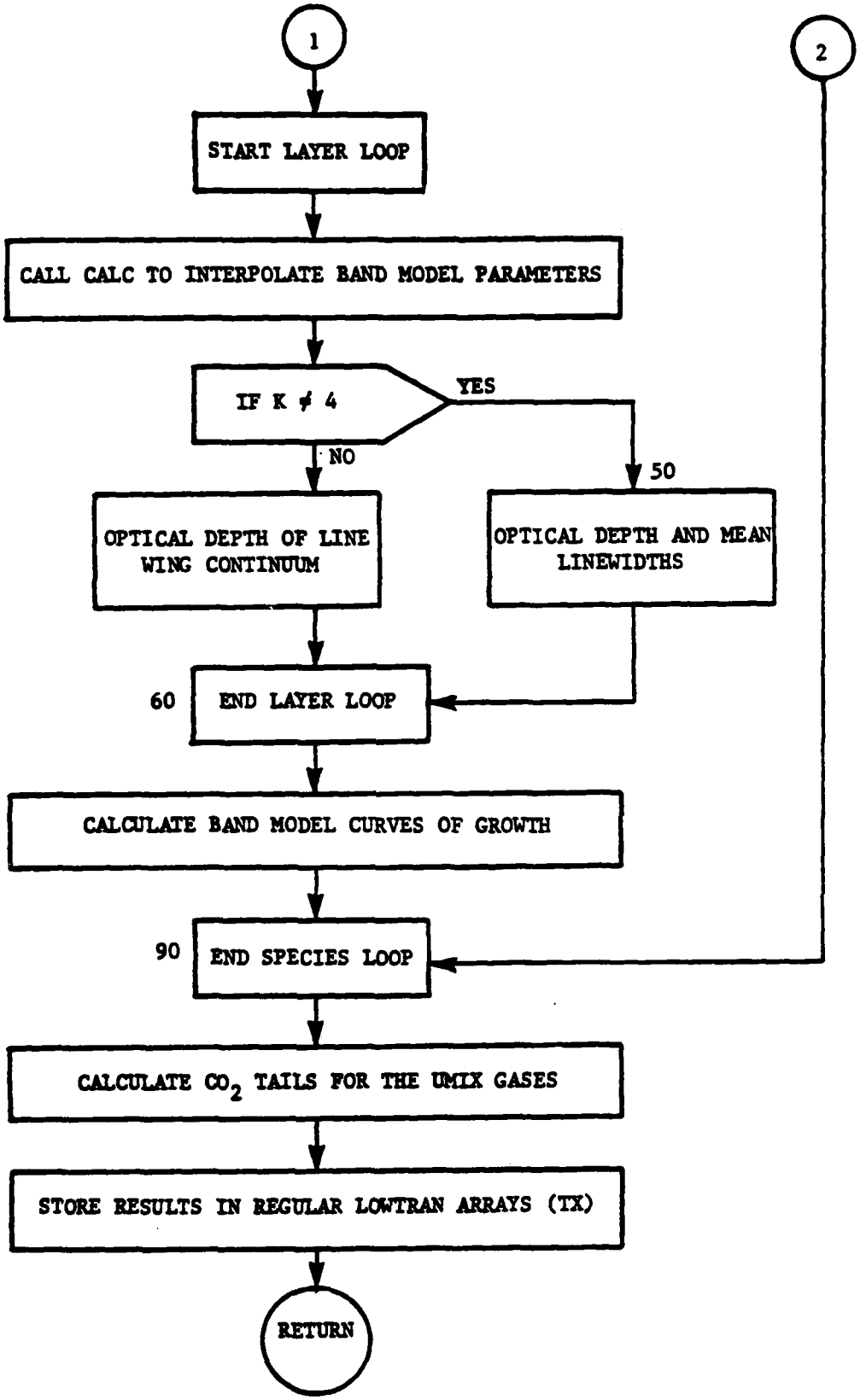
SUBROUTINE BMDATA



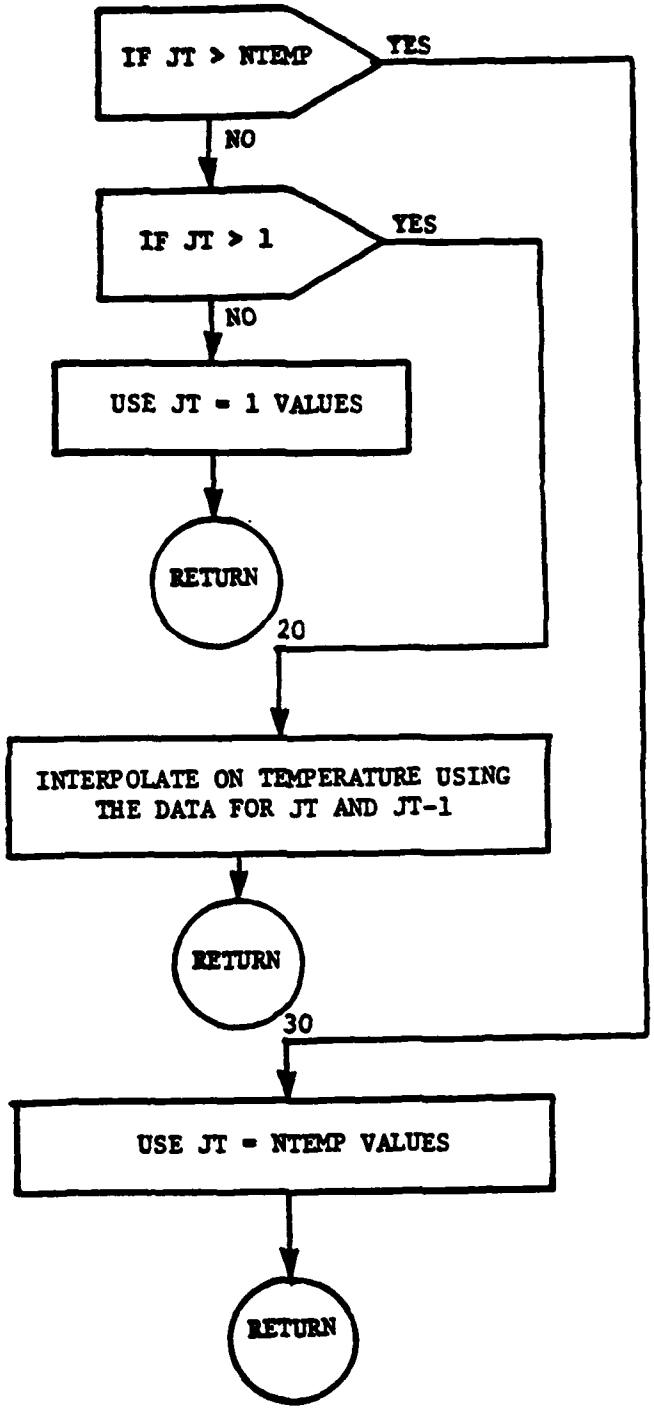
SUBROUTINE BMOD



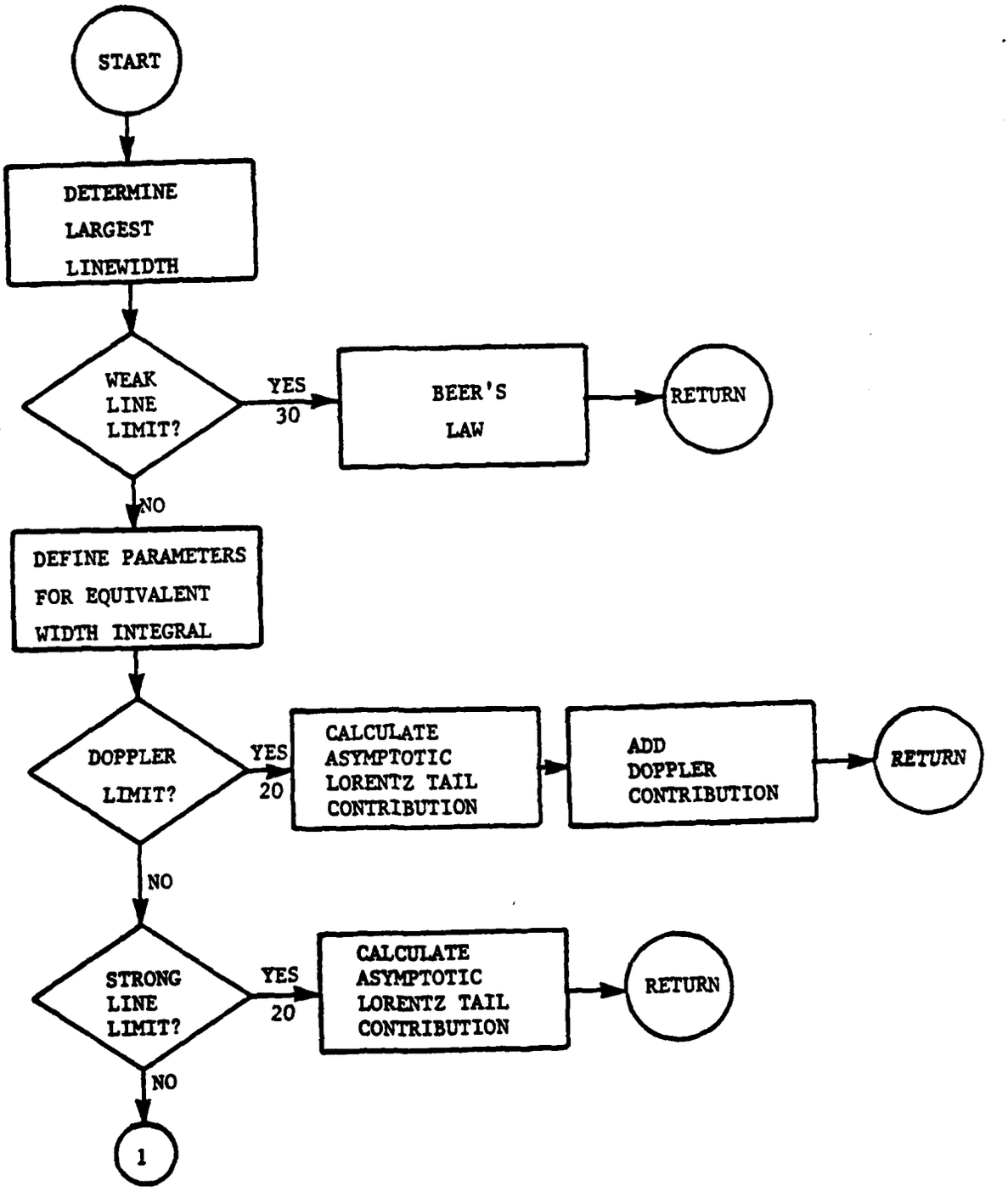
SUBROUTINE EMOD (Cont.)



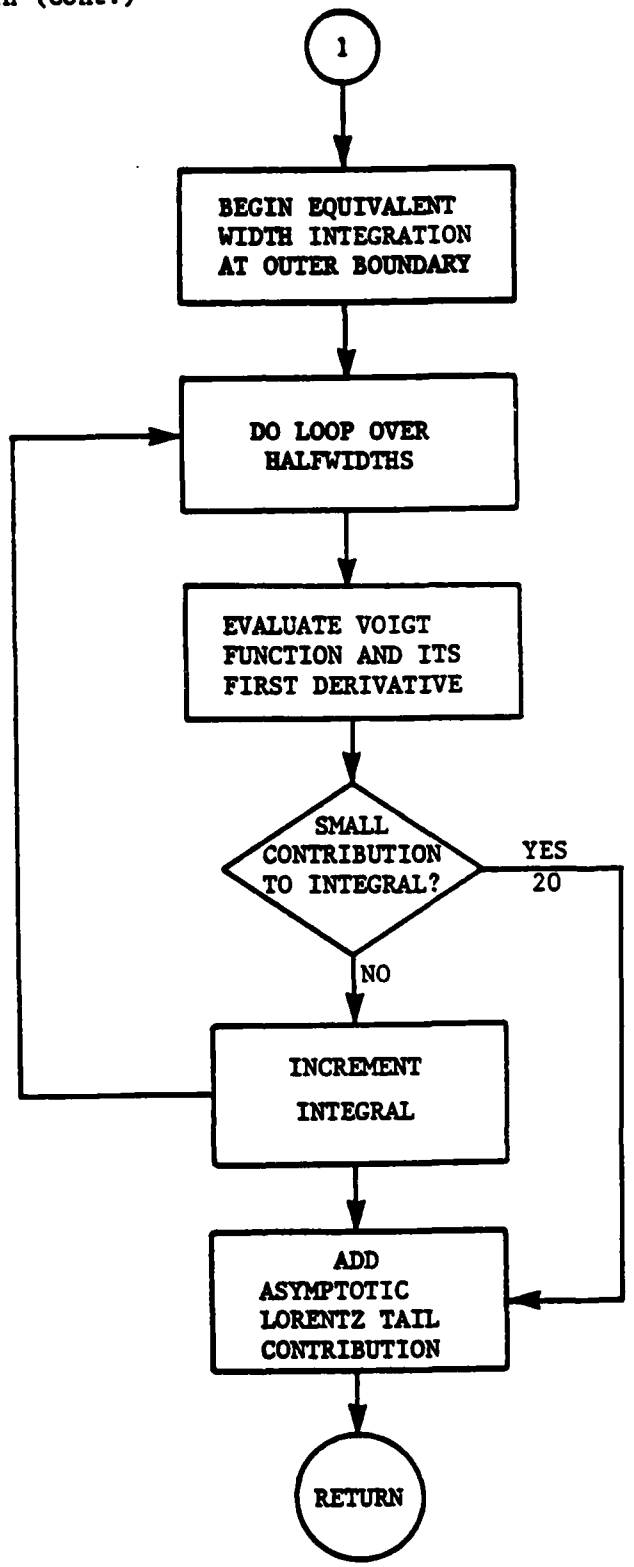
SUBROUTINE CALC



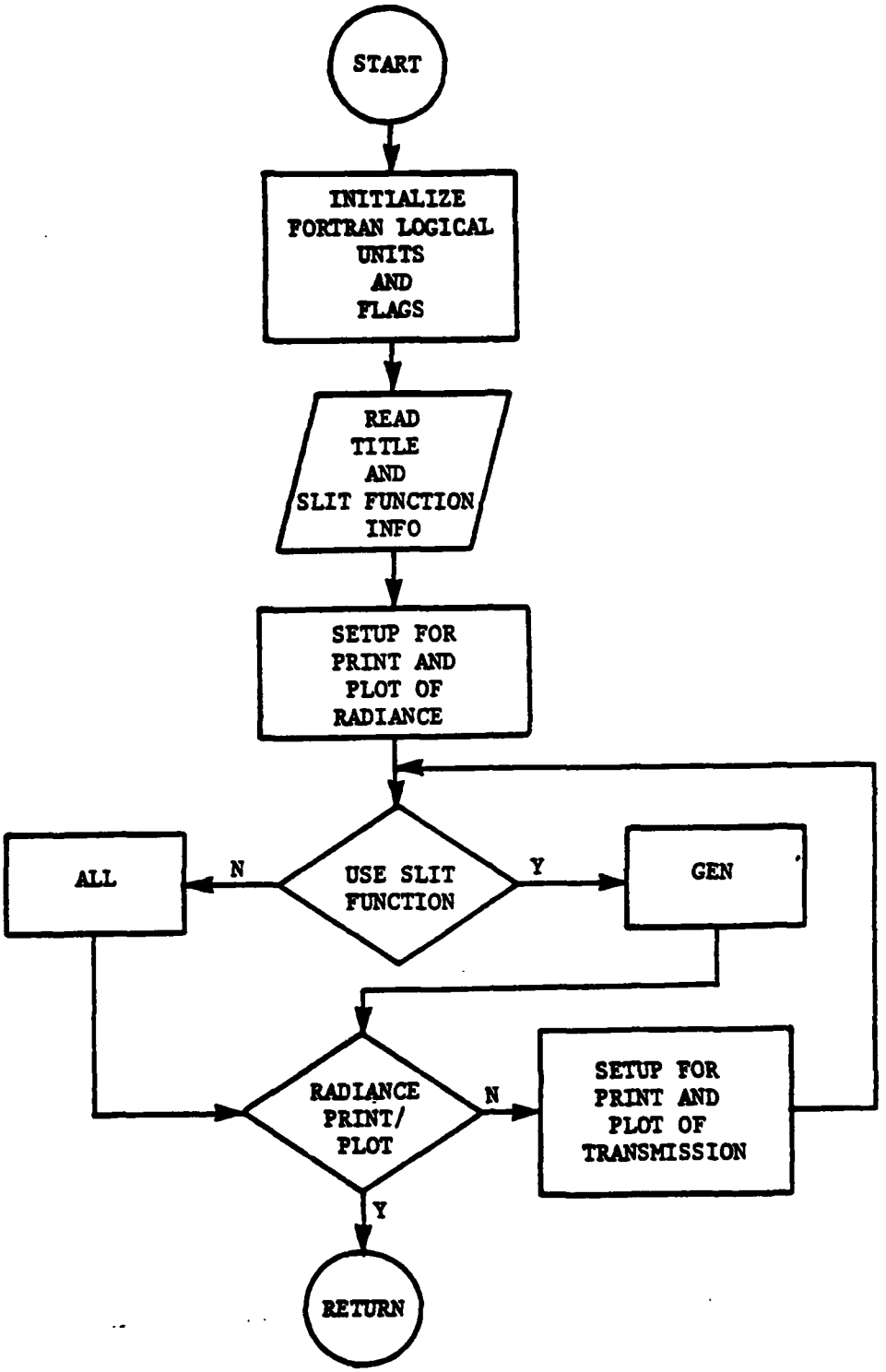
SUBROUTINE EWIDTH



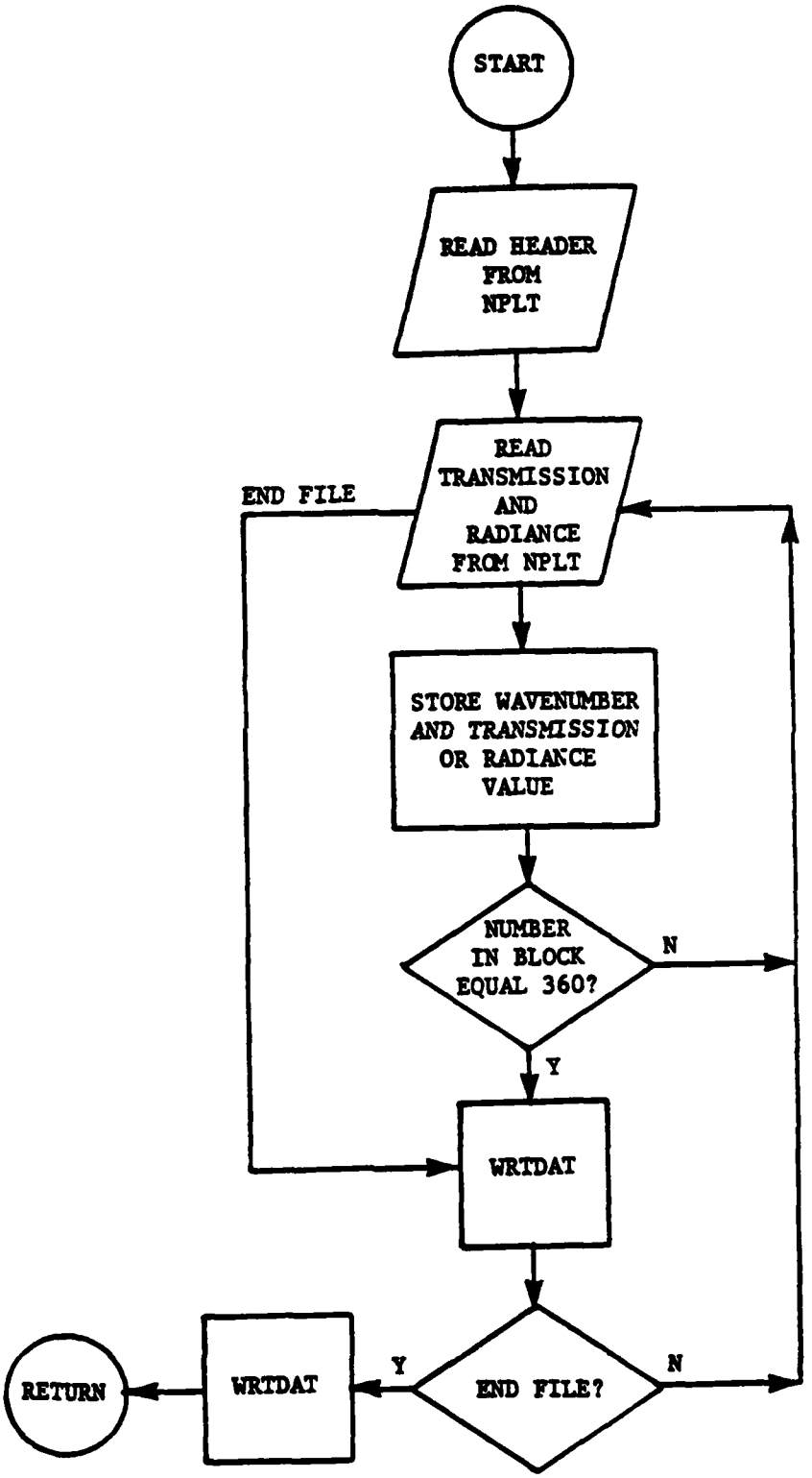
SUBROUTINE EWIDTH (Cont.)



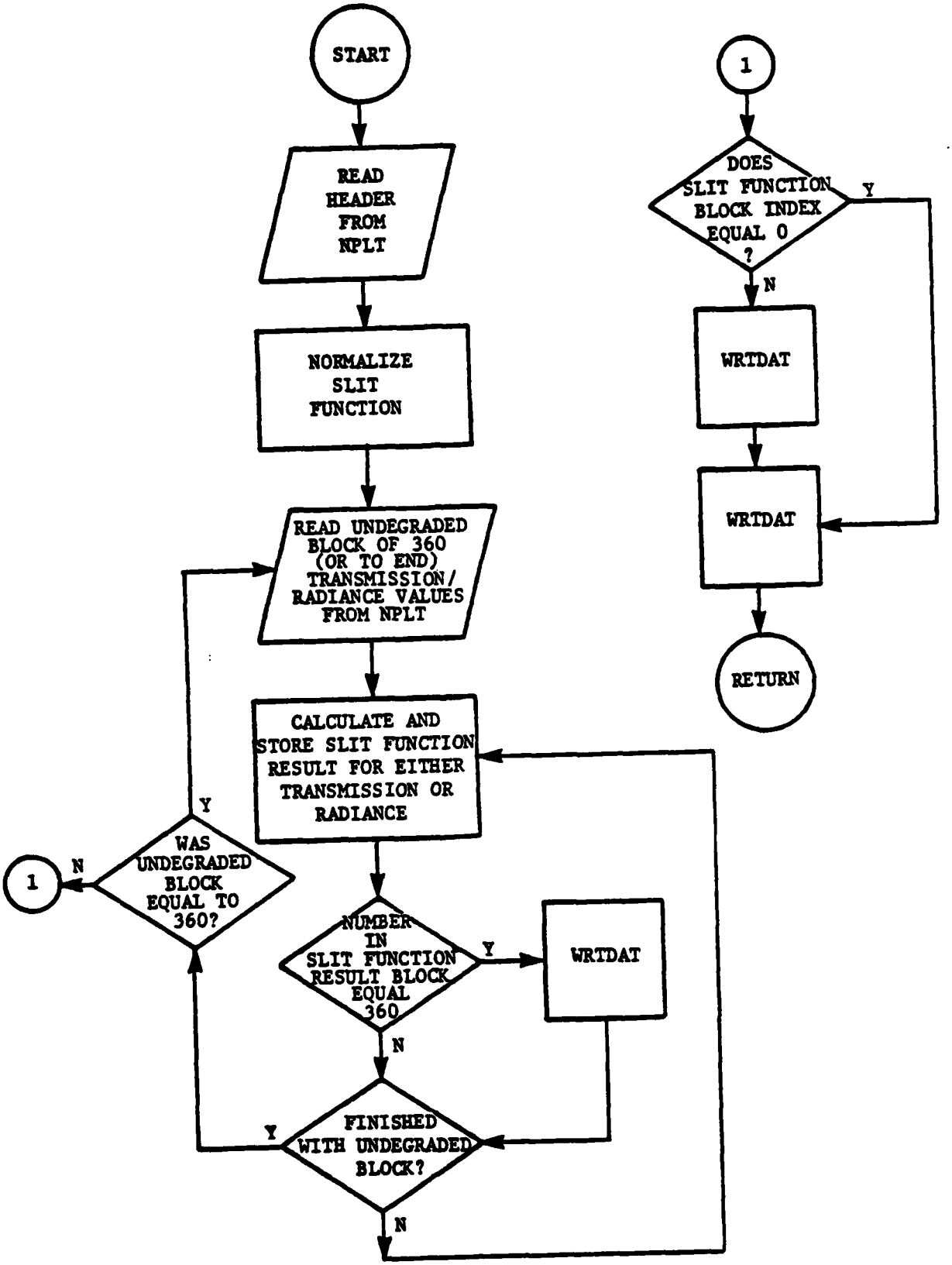
SUBROUTINE LIB



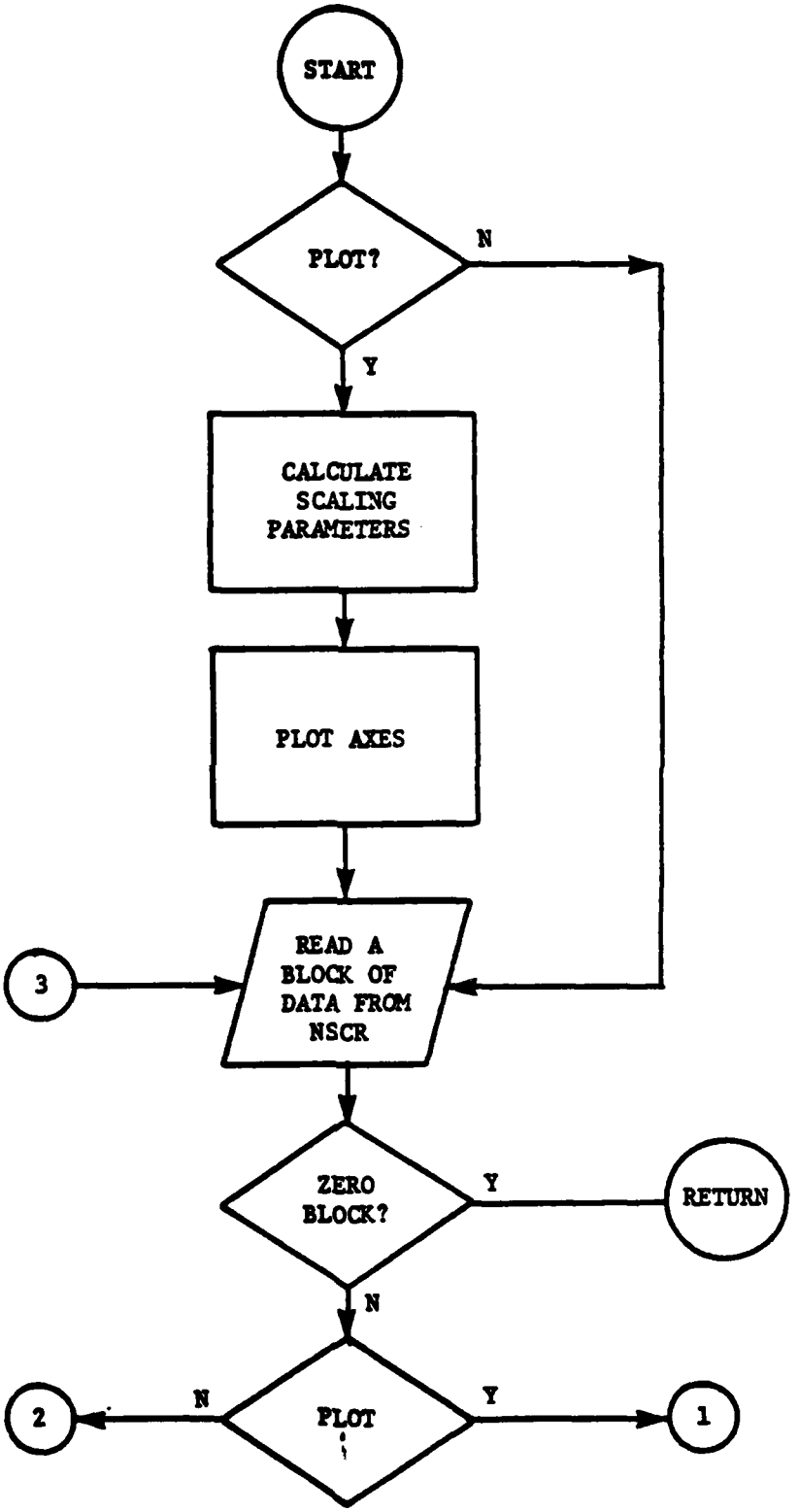
SUBROUTINE ALL

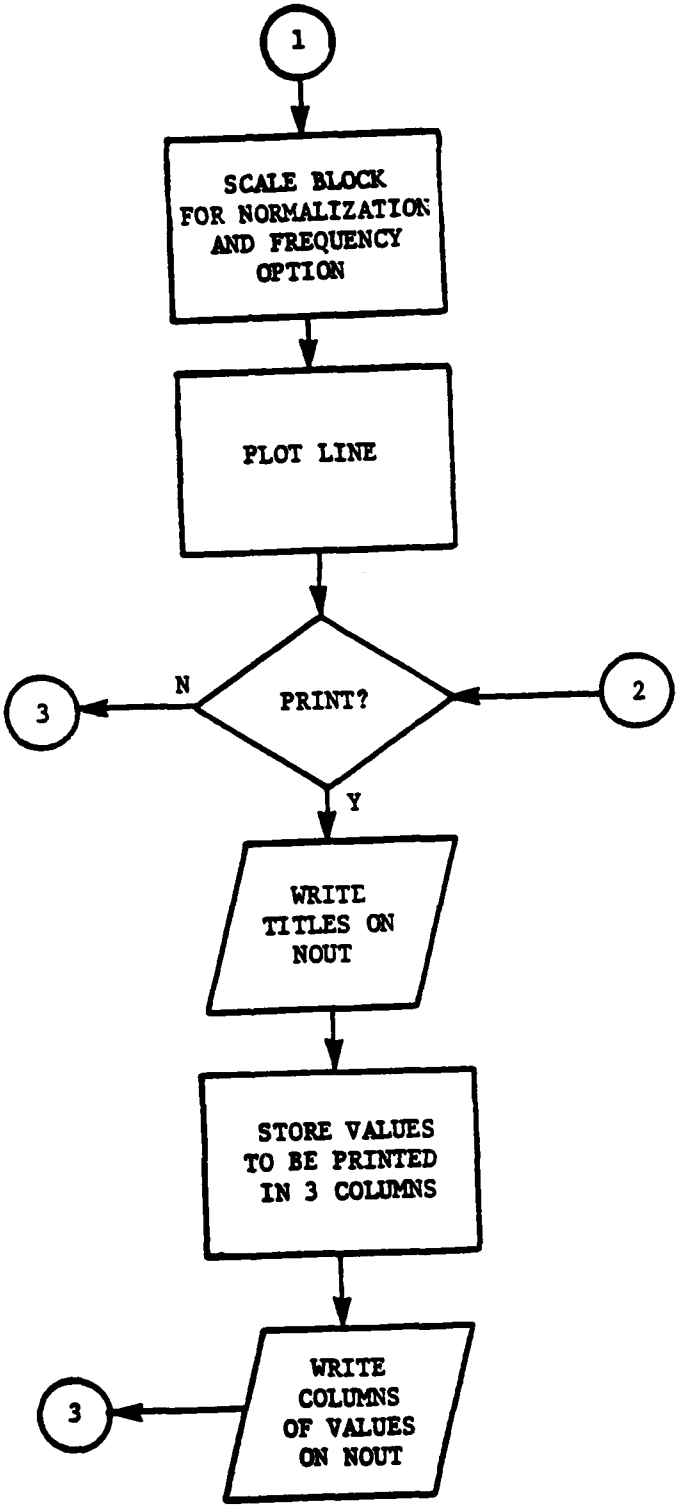


SUBROUTINE GEN

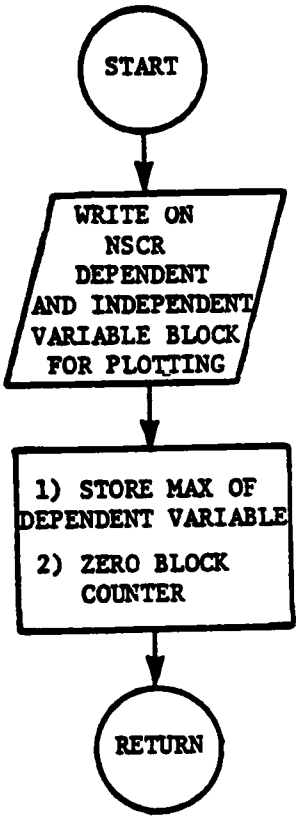


SUBROUTINE PROUT

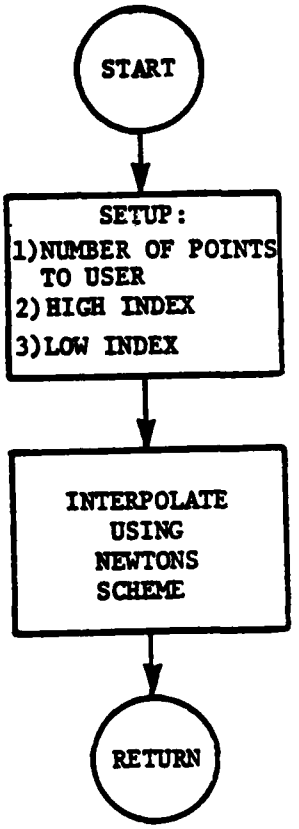



1
SCALE BLOCK FOR NORMALIZATION AND FREQUENCY OPTION
PLOT LINE
PRINT?
N
3
2
Y
WRITE TITLES ON NOUT
STORE VALUES TO BE PRINTED IN 3 COLUMNS
WRITE COLUMNS OF VALUES ON NOUT
3

SUBROUTINE WRTDAT



SUBROUTINE TERP



APPENDIX C

LIST OF VARIABLES

C.1 NEW SUBROUTINES

C.2 COMMON BLOCKS

C.1 NEW SUBROUTINES

- SUBROUTINE BMDATA -

IDV	Frequency Increment
IK	Loop Counting Variable for Layers
IT	Loop Counting Variable for Temperature
J	Loop Counting Variable
JBLOCK	Number of Data Blocks for the Initial Read
JV	Loop Counting Variable for Reading the Tape
K	Loop Counting Variable for Species
KSPEC	Number of Species on Data Tape
N	Loop Counting Variable for Temperature
NV	Number of Wavenumber Entries on the Tape
TT	Temperature
UNITS	Conversion Factors to Units of cm amagat
VA	Lowest Frequency on Data Tape
VB	Highest Frequency on Data Tape

- SUBROUTINE BMOD -

ABSM	Value of S/d Returned by CALC
ACBAR	Mean Lorentz Halfwidth Times Line Density
ADBAR	Mean Doppler Halfwidth Times Line Density
ANLINE	Number of Equivalent Lines in an Interval
DINV	Line Density Parameter (1/d)
FAC1	Incremental Optical Depth
FAC2	Constant for Doppler Lineshape
FAC3	Constant for Collision Curve of Growth Calculation
JT	Index for Temperature Interpolation of Band Model Parameters
JV	Loop Counting Variable for Reading the Data Tape
K	Species Loop Counting Variable
KSPEC	Number of Species on Data Tape
L	Loop Counting Variable for Layers
LMAX	Upper Limit of Layer Loop
LMIN	Lower Limit of Layer Loop
N	Loop Counting Variable
ODBAR	Mean Value of the Line Density (1/d)
S1	Summing Variable for ACBAR
S2	Summing Variable for ADBAR
S3	Summing Variable for ODBAR
TRANS	Transmittance
TT	Temperature
WSL	Equivalent Width of a Single Line
XS	Optical Depth

- SUBROUTINE EWIDTH -

ACBAR	Path Average Collision Linewidth Times Line Density
ADBAR	Path Average Doppler Linewidth Times Line Density
ALFC	Path Average Collision Linewidth
ALFD	Path Average Doppler Linewidth
ALFMAX	Larger of ALFC or ALFD
ASYMP	Asymptotic Lorentz Tail Contribution to Equivalent Width
C1	$\sqrt{\ln 2}$
C2	$\sqrt{\ln 2/\pi}$
C3	$(Su/\gamma_D)C1$
C4	C1/ALFD
CDRAT	Lower Limit of RAT for Switching to Doppler Limit
DELW	Integration Step Size
DELX	Nondimensional Integration Step Size
DV	Spectral Resolution of Calculation
EXPØ	Voigt Contribution to Equivalent Width Integral
EXP1	First Derivative Voigt Contribution to Equivalent Width Integral
FAC	Intermediate Calculation Factor
HALFDV	DV/2
ISTEP	Determines Integration Step Size
NALF	Number of Halfwidths to Outer Integration Boundary
NMAX	Number of Integration Points from Outer Boundary to Line Center
ODBAR	Path Average Line Density
RAT	ALFC/ALFD
RT2	$\sqrt{2}$
RTPI	$\sqrt{\pi}$
SUM	Current Value of Equivalent Width Integral
TTRANS	Beer's Law Transmittance
U1	Variable used in Calculation of Asymptotic Tail Contribution to Equivalent Width
U2	Same as for U1

SUBROUTINE EWIDTH (Cont.)

WI	Imaginary Part of Complex Error Function
WR	Real Part of Complex Error Function (Voigt Function)
WR1	First Derivative of WR
WSL	Equivalent Width
X	Nondimensional Frequency
XMIN	Outer Boundary for Numerical Integration of Equivalent Width Integral
XS	Used for Weak and Strong Line Limit Checks
XSMAX	Lower Limit for Switching to Strong Line Limit
XSMIN	Upper Limit for Switching to Weak Line Limit
XSTAR	Weak Line Optical Depth
Y	$\sqrt{\ln 2}\ \gamma_C/\gamma_D$

- SUBROUTINE LIB -

BLANK	4 Spaces (Hollerith)
DY	Change in Y Axis Value Per Plotted Major Tic Mark
I	Do Loop Variable
ITY	<0 For Transmission, >0 For Radiance
IX	Axis Annotation Index
IXT	Vector of Number of Characters Per Annotation of X Axis
IYT	Vector of Number of Characters Per Annotation of Y Axis
JSLOT	Stores Current MSLT
LPLT	Plot Initial Reaction Flag
MPLT	Plot Type
MPLTN	Value Input as Plot Type
MPRT	Print Type
MPRTN	Value Input as Print Type
MSLT	Value Input as Slit Function Type
MSLTO	Last Slit Function Type
NS	Number of Entries Input in Slit Function
NSN	Value Input for NS
PLTR	Flag for Reading Plot Input
PRTR	Flag for Reading Print Input
SHIFT	Slit Function Shift
SHIFTN	Value Input for SHIFT
SS	Weighting Values for Slit Function
WIDTH	Total Width of Slit Function in cm^{-1}
WIDTHN	Value Input for WIDTH
XEND	Upper Limit for X Axis
XORG	Plot Origin on Plotter Bed (X Coordinate)

SUBROUTINE LIB (Cont.)

XSS	Wavenumber Coordinate for Slit Function
XTIT	Array of X Axis Titles
YEND	Upper Limit for Y Axis
YINI	Input Value for YINIT of Common/YBLOCK/
YORG	Plot Origin in Plotter Bed (Y Coordinate)
YTIT	Array of Y Axis Titles

- SUBROUTINE ALL -

DV	Wavenumber Interval for Data Stored on NPLT
DVM	Double Precision Version of DV
N	Number of Data Points Passed to WRTDAT
V	Vector That Stores Transmission and Radiance Values
XFF	Wavenumber Counter

- SUBROUTINE GEN -

AREA	Area Calculated Under the Slit Function
DV	Wavenumber Interval for Data Stored on NPLT
DVM	Double Precision Version of DV
FAC	Wavenumber Factor for Slit Function Points
FIRST	Logical Variable to Indicate the Number of Passes Through The Routine
I	Do Loop Variable
IER	Argument of TERP
IS	Slit Function Index
IX	Wavenumber Counter
IXX	First Wavenumber Index in Group
J	Do Loop Variable
N	Number of Degraded Data Points Passed to WRTDAT
NDEG	Order of Interpolation Performed on TERP
NF	Number of Undegraded Wavenumber Points in Block
NS	Number of Slit Function Points
S	Scaled Weighting Values for the Slit Function
SHIFT	The Slit Function Shift for the Next Calculation of the Degraded Spectrum
SS	Weighting Values for the Slit Function
SUM	Integrated Slit Function Value
TERPV	Interpolated Value
V	Vector that Stores Transmission and Radiance Values
WIDTH	Width of Slit Function in Wavenumbers
XC	Centered Slit Function
XF	Wavenumber of Block Beginning
XFF	Wavenumber Counter
XMID	Wavenumber Center of Slit
XS	Wavenumber Coordinates of Slit Function
XSS	Unscaled Wavenumber Coordinates of Slit Function
XX	Wavenumber Counter in Block

- SUBROUTINE PROUT -

DUMFAC	Dummy Returned Scale Factor From WHERE
FIRST	Logical Flag Which Indicates the First Time Through the Routine
I	Do Loop Index
I1	Data Index for Print Out
DEXP	Normal Ratio Exponent for Plotting
II	Line Number for Print Out
J	Do Loop Index
K	Implied Do Loop Index
N	Number of Points in the Data Block
N1	Number of Points in the Plotting Block of Data
NCOL	Column Number for Print Out
NI	Number of Lines to Print
NN	End Index of Print Page
NN3	Number of Lines on Print Page
OUT	Print Our Array
TEXP	Temporary Exponent Storage for Plot Normalization
TNORM1	Characters Used for Normalization Title
TNORM2	TNORM1 Part 2
VSX	Wavenumber Temporary Storage
XEND	End of X Axis Plot
XNORM	X Coordinate for Normalization Title
XPT	X Coordinate for Plotted Point
YCHECK	YMAX Check for Normalization
YNORM	Y Coordinate for Normalization Title
YPT	Y Coordinate for Plotted Point

- SUBROUTINE WRTDAT -

FLAG	Logical Flag for Wavenumber to Frequency Conversion
I	Do Loop Index
N	Number of Data Points in X and Y
X	Vector of Independent Variables (Wavenumber or Frequency)
Y	Vector of Dependent Variables (Transmission or Radiance)
YI	Temporary Storage of Y(I)

- SUBROUTINE TERP -

CON	Temporary Storage of Interpolation Function
HI	High Index for Interpolation of X Vector
I	Do Loop Index
IA	Temporary Index for Interpolation Calculation
IER	Interpolation, Extrapolation Flag
IL	Lower Limit for Interpolation
IM	Low Index -1
IR	Range Index
IS	Temporary Index for Interpolation Calculation
K	Do Loop Index
LOW	Low Index for Interpolation of X Vector
N	Number of Points Used in the Interpolation
NDEG	Degree of Interpolating Polynomial
NFIT	NDEG + 1
NPTS	Number of Entries in X and Y
VAL	Temporary Interpolation Value
X	Vector of Independent Variables
XC	Value of Independent Variable at Which the Interpolated Value For the Dependent Variable is Desired
Y	Vector of Dependent Variables
Y1	Temporary Storage Vector for Intermediate Results

C.2 COMMON BLOCKS

- COMMON /BMDCOM/ SD, OD, ZMWT, ALFØ, WT, JJ, IW, NTEMP, TBAND -

ALFØ	Molecular Linedwidth at STP
IW	Counting Variable for Frequencies Within a Tape Data Block
JJ	Indices for Temperature Interpolation of BM Parameters
NTEMP	Number of Temperatures for Tabulated BM Parameters
OD	Mean Line Density (1/d)
SD	Band Model Absorption Parameter (S/d)
TBAND	Temperatures for Tabulated BM Parameters
WT	Square Root of Temperature
ZMWT	Mean Molecular Weight

- COMMON /BMDCOM/ SD, OD, ZMWT, ALFØ, WT, JJ, IW, NTEMP, TBAND -

ITYPE	Print/Plot Type -1 Transmission, -2 Radiance
ISLOT	Plot Flag - >0 Plot, <0 No Plot
NEWT	Units Flag - >0 cm^{-1}, <0 μm
IPRT	Print Flag - >0 Print, <0 No Print

- COMMON /SETUP/ ITYPE, ISLOT, NEWT, IPRT

F	A Storage Vector of 360 in Length

- COMMON /BLOCK2/Y,X [OR YY,XX IN PROUT] -

Y	A Storage Vector of Dependent Variables for Print/Plot of 363 in Length
X	A Storage Vector of Independent Variables for Print/Plot of 363 in Length

- COMMON /BLOCK3/ARRAY [OR Y IN PROUT] -

ARRAY	A Storage Vector of 363 in Length

- COMMON /VS/ VS1, VS2 -

VS1	Lower Bound for Spectral Information in Current Block
VS2	Upper Bound for Spectral Information in Current Block

- COMMON /MAXY/YMAX -

YMAX	Largest Value Written on NSCR Used for Plot Scaling

- COMMON /PLTDEV/NSCR, NPLTR -

NSCR	FORTRAN Logical Unit for the Temporary Storage of Degraded Spectra
NPLTR	FORTRAN Logical Unit for the CALCOMP-Type Plotter

- COMMON /XBLOCK/XTITLE, XAXIS, XINIT, YSCALE, DXT, NMINX -
/YBLOCK/YTITLE, YAXIS, YINIT, YSCALE, DYT, NMINY

XTITLE YTITLE	Vectors of 20 in Length Which Store the Axes Titles
XAXIS YAXIS	Axis Length in Inches
XINIT YINIT	Starting Value for the Respective Axis
XSCALE YSCALE	Change in Axis Value Per Inch for the X-Axis and Y-Axis Respectively
DXT DYT	Change in Axis Value Per Plotted Major Tic Mark
NMINX NMINY	Number of Minor Tic Marks (Between Major Tics) for Each Axis

- COMMON /PBLOCK/TITLE, ICHAR, JCHAR, KCHAR -

TITLE	A Vector of 20 In Length That Stores the Print/Plot Title
ICHAR	Number of Characters in X-Axis Annotation (XTITLE)
JCHAR	Number of Characters in Y-Axis Annotation (YTITLE)
KCHAR	Number of Characters in TITLE

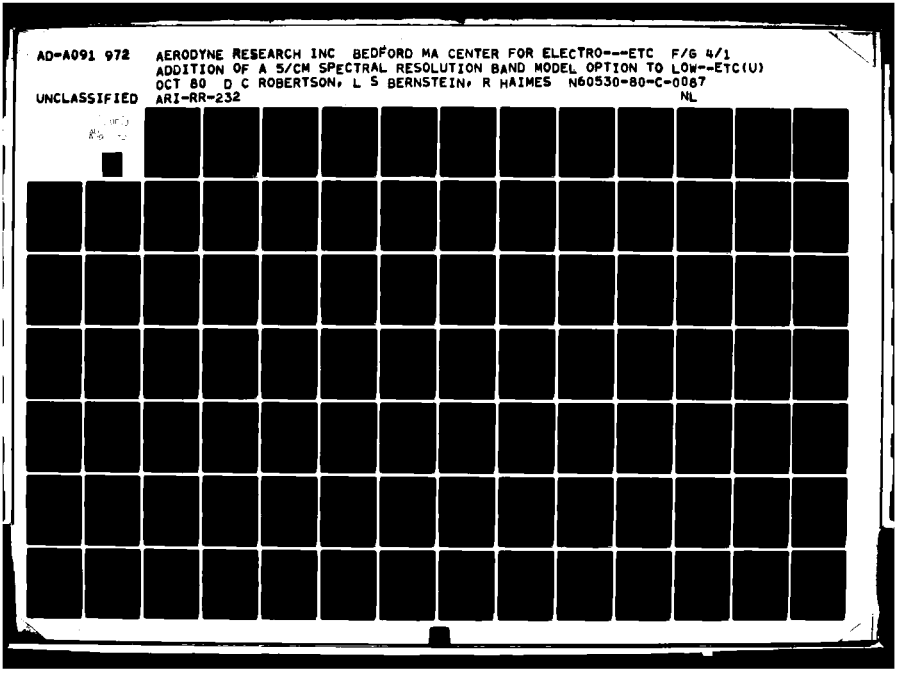
APPENDIX D

LISTING OF MODIFIED LOWTRAN5

Changes required to implement the BMOD option are indicated by an asterisk before the line number. The optional changes are indicated by a colon.

```
C     PROGRAM LOWEM(INPUT=128,OUTPUT=128,TAPE6=OUTPUT,          TAPE9,    LOW  *10
C    *   TAPE11,TAPE12,TAPE5=INPUT)                                       LOW  *11
C                                                                         LOW  *12
C     MODIFIED FOR 5 CM-1 BAND MODEL  ---  OCTOBER 1980                   LOW  *13
C     INCLUDES AERODYNE PLOT PACKAGE                                      LOW  :14
C                                                                         LOW  *15
C     ************************************************************************LOW   20
C     LOWTRAN      1 NOV 79                                               LOW   30
C                                                                         LOW   40
C               AUTHORS                                                   LOW   50
C               F.X.KNEIZYS                                               LOW   60
C               E. P. SHETTLE                                             LOW   70
C               L. W. ABREU                                               LOW   80
C               J. H. CHETWYND JR.                                        LOW   90
C               J.E.A. SELBY                                              LOW  100
C               W. O. GALLERY                                             LOW  110
C               R. W. FENN                                                LOW  120
C               R. A. MCCLATCHEY                                          LOW  130
C                                                                         LOW  140
C     PROGRAM LOWTRAN  CALCULATES THE TRANSMITTANCE    AND/OR RADIANCE    LOW  150
C     OF THE ATMOSPHERE                                                   LOW  160
C     FROM 350 CM-1 TO 40000 CM-1 (0.25 TO 28.57 MICRONS) AT 20 CM-1      LOW  170
C     SPECTRAL RESOLUTION ON A LINEAR WAVENUMBER SCALE.                   LOW  180
C     REFRACTION AND EARTH CURVATURE EFFECTS ARE INCLUDED.    ATMOSPHERELOW  190
C     IS LAYERED IN ONE KM. INTERVALS BETWEEN 0 AND 25 KM., 5 KM. INTER-LOW  200
C     VALS TO 50 KM., A TWENTY KM. INTERVAL TO 70 KM., AND A THIRTY KM. LOW  210
C     INTERVAL TO 100 KM.                                                 LOW  220
C     ************************************************************************LOW  230
C                                                                         LOW  240
C     THE FOLLOWING CARDS SHOULD BE KEYPUNCHED BY THE USER                LOW  250
C     AND MAILED TO: F.X.KNEIZYS,AFGL/OPI,HANSCOM AFB,MASS 01731          LOW  260
C     THE CARDS WILL BE USED TO UPDATE THE AFGL MALING LIST               LOW  270
C     AND FOR NOTIFICATION TO THE USER OF ERRORS IN THE CODE              LOW  280
C                                                                         LOW  290
C                                                                         LOW  300
C             (USE COLUMNS 21 TO 72)                                      LOW  310
C     LOWT5    NAME                                                       LOW  320
C     LOWT5 COMPANY                                                       LOW  330
C     LOWT5 ADDRESS                                                       LOW  340
C                                                                         LOW  350
C                                                                         LOW  360
C     ************************************************************************LOW  370
C                                                                         LOW *371
C     THIS VERSION OF LOWTRAN5 HAS BEEN MODIFIED BY AERODYNE RESEARCH,    LOW *372
C     TO PERFORM THE CALCULATIONS AT A SPECTRAL RESOLUTION OF 5 CM-1.     LOW *373
C     THIS WORK WAS SUPPORTED BY THE NAVY OPTICAL SIGNATURES PROGRAM,     LOW *374
C     CHINA LAKE, CALIFORNIA                                              LOW *375
C                  AUTHORS                                                LOW *376
C                  L. S. BERNSTEIN                                        LOW *377
C                  D. C. ROBERTSON                                        LOW *378
C                  R. HAIMES                                              LOW *379
C                                                                         LOW *37A
C     FOR CALCULATIONS AT 5 CM-1, THE USER MUST USE AN EXTERNAL FILE      LOW *37B
```

AD-A091 972 AERODYNE RESEARCH INC BEDFORD MA CENTER FOR ELECTRO--ETC F/G 4/1
ADDITION OF A 5/CM SPECTRAL RESOLUTION BAND MODEL OPTION TO LOW--ETC(U)
OCT 80 D C ROBERTSON, L S BERNSTEIN, R HAIMES N60530-80-C-0087
UNCLASSIFIED ARI-RR-232 NL



```
C     (FILE NO. NTBL) WHICH HAS THE BAND MODEL PARAMETERS.  THE 5 CM-1  LOW *37C
C     BAND MODEL PARAMETERS HAVE BEEN GENERATED FROM THE AFGL HITRAN    LOW *37D
C     LINE ATLAS FOR THESE SEVEN ATMOSPHERIC MOLECULES:                 LOW *37E
C                H2O, CO2, O3, CH4, NO, CO AND O2.                      LOW *37F
C     FOLLOWING THE LOWTRAN FORMAT, H2O & O3 ARE CALCULATED SEPARATELY, LOW *37G
C     WHILE THE OTHERS ARE LUMPED INTO THE UNIFORMLY MIXED GASES (CO2+) LOW *37H
C                                                                       LOW *37I
C        ************************************************************** LOW *37J
C                                                                       LOW *37K
C     PROGRAM ACTIVATED BY SUBMISSION OF FOUR CARD SEQUENCE AS FOLLOWS  LOW  380
C                                                                       LOW  390
C     CARD 1 MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO,TBOUND,  LOW  400
C    1ISEASN,IVULCN,VIS,JBMOD                                           LOW *410
C                                        FORMAT(11I3,2F10.3,2I3,F11.3,I2)  LOW *420
C     CARD 2 H1,H2,ANGLE,RANGE,BETA                  FORMAT(7F10.3)     LOW  430
C     CARD 3 V1, V2, DV                              FORMAT(7F10.3)     LOW  440
C     CARD 4 IXY                                     FORMAT(I3)         LOW  450
C     ******* ADDITIONAL INPUT CARDS FOR THE PRINT/PLOT PACKAGE *******  LOW :451
C     CARD 5  TITLE                            FORMAT(20A4)             LOW :452
C     CARD 6  MSLT,MPRT,MPLT,NS,WIDTH,SHIFT    FORMAT(4I2,2X,2F10.0)    LOW :453
C     CARD 7A XSS                              FORMAT(8F10.5)           LOW :454
C     CARD 7B SS                               FORMAT(8F10.5)           LOW :455
C     CARD 8A XAXIS,XINIT,XEND,DXT,NMINX       FORMAT(4E10.4,I10)       LOW :456
C     CARD 8B YAXIS,YINIT,YEND,DYT,NMINY       FORMAT(4E10.4,I10)       LOW :457
C                                                                       LOW  460
C     MODEL=1,2,3,4,5 OR 6 SELECTS ONE OF THE FOLLOWING MODEL ATMOSPHERELOW  470
C     TROPICAL,MIDLATITUDE SUMMER,MIDLATITUDE WINTER,SUBARCTIC SUMMER,  LOW  480
C     SUBARCTIC WINTER,OR THE 1962 U.S.  STANDARD RESPECTIVELY          LOW  490
C     MODEL=10 SKIPS DIRECTLY TO PLOTTING PACKAGE USING OLD NPLT FILE   LOW :491
C     MODEL=0 FOR HORIZ. PATH WHEN METEOROL. DATA USED\INSTEAD OF CARD 2LOW  500
C     READ H1,P(MB),T(DEG C),DEW PT.TEMP(DEG C),%REL HUMIDITY,H2O DENSITLOW  510
C     (GM.M-3),O3 DENSITY(GM.M-3), RANGE(KM) WITH FORMAT 429.           LOW  520
C     MODEL=7 WHEN NEW MODEL ATMOSPHERE(E.G. RADIOSONDE DATA) USED.     LOW  530
C     DATA CARDS ARE READ IN BETWEEN CARDS 1 AND 2, AND SHOULD CONTAIN\ LOW  540
C     ALTITUDE(KM.),PRESSURE,TEMP,DEW PT.TEMP,REL. HUMIDITY,H2O DENSITY,LOW  550
C     O3 DENSITY,AEROSOL NO. DENSITY      ,VIS1,IHA1,ISEA1,IVUL1  FORMATLOW  560
C     435  SEE NSMDL FOR DETAILS.                                       LOW  570
C     NOTE THAT EITHER DEW PT. TEMP.OR REL. HUMIDITY CAN BE USED.       LOW  580
C                                                                       LOW  590
C     M1,M2,M3, ARE USED TO CHANGE TEMP,H2O, AND O3 ALTITUDE PROFILES.  LOW  600
C        IEMISS=0=TRANSMISSION MODE / IEMISS=1=EMISSION MODE            LOW  610
C        TBOUND=TEMPERATURE OF EARTH IN DEGREES KELVIN                  LOW  620
C        IF TBOUND = ZERO, ASSUMES AIR TEMPERATURE OF MODEL ATMOS.      LOW  630
C                                                                       LOW  640
C     IF IHAZE=0 NO AEROSOL EXTINCTION IS COMPUTED                      LOW  650
CCC   VIS PARAMETER ON CARD 1 OVERRIDES DEFAULT IHAZE VALUE             LOW  660
CCC   NOTE EXPANSION OF IHAZE PARAMETER                                 LOW  670
C     IHAZE=1  RURAL-23KM                                               LOW  680
C     IHAZE=2  RURAL- 5KM                                               LOW  690
C     IHAZE=3  MARITIME-23KM                                            LOW  700
C     IHAZE=4 MARITIME-5KM                                              LOW  710
C     IHAZE=5 URBAN-5KM                                                 LOW  720
C     IHAZE=6 TROPOSPHERIC-50KM                                         LOW  730
```

```
C     IHAZE=7  USER DEFINED                                                  LOW  740
C     IHAZE=8 FOG1 - DEFAULT VISIBILITY =0.2KM                               LOW  750
C     IHAZE=9 FOG2 - DEFAULT VISIBILITY =0.5KM                               LOW  760
C     VISIBILITY PROFILES  (NEW PARAMETER-ISEASN)                            LOW  770
C     ISEASN=0  DEFAULTS TO SEASON OF MODEL                                  LOW  780
C     ISEASN=1 SPRING-SUMMER                                                 LOW  790
C     ISEASN=2  FALL-WINTER                                                  LOW  800
C     NEW PARAMETER - IVULCN                                                 LOW  810
C              10-30KM AEROSOL TYPE/VIS PROFILE                              LOW  820
C     IVULCN=0  DEFAULT TO STRATOSPHERIC BACKGROUND                          LOW  830
C     IVULCN=1  STRATOSPHERIC BACKGROUND                                     LOW  840
C     IVULCN=2  AGED VOLCANIC TYPE/MODERATE VOLCANIC PROFILE                 LOW  850
C     IVULCN=3  FRESH VOLCANIC TYPE/HIGH VOLCANIC PROFILE                    LOW  860
C     IVULCN=4  AGED VOLCANIC TYPE/HIGH VOLCANIC PROFILE                     LOW  870
C     IVULCN=5  FRESH VOLCANIC TYPE/MODERATE VOLCANIC PROFILE                LOW  880
C                                                                            LOW  890
C     ITYPE=1,2  OR 3 INDICATES THE TYPE OF ATMOSPHERIC PATH                 LOW  900
C     ITYPE=3,VERTICAL OR SLANT PATH TO SPACE                                LOW  910
C     ITYPE=2,VERTICAL OR SLANT PATH BETWEEN TWO ALTITUDES                   LOW  920
C     ITYPE=1, CORRESPONDS TO A HORIZONTAL (CONSTANT PRESSURE) PATH          LOW  930
C                                                                            LOW  940
C     JBMOD = 0  DEFAULTS TO LOWTRAN5                                        LOW *941
C           = 1  SELECTS THE 5 CM-1 BAND MODEL OPTION                        LOW *942
C                                                                            LOW *943
C     H1=OBSERVER ALTITUDE (KM)                                              LOW  950
C     H2=SOURCE  ALTITUDE (KM)                                               LOW  960
C     ANGLE= ZENITH ANGLE AT H1 (DEGREES)                                    LOW  970
C     RANGE=PATH LENGTH (KM)                                                 LOW  980
C     BETA=EARTH CENTRE ANGLE                                                LOW  990
C     VIS = VISUAL RANGE AT SEA LEVEL (KM)                                   LOW 1000
C     (IF ITYPE=1 READ H1 AND RANGE;IF ITYPE=3 READ H1 AND ANGLE.            LOW 1010
C     IF ITYPE=2 READ H1 AND TWO OTHER PARAMETERS E.G. H2 AND ANGLE)         LOW 1020
C                                                                            LOW 1030
C     V1=INITIAL FREQUENCY (WAVENUMBER CM-1 ) INTEGER VALUE                  LOW 1040
C     V2=FINAL FREQUENCY(WAVENUMBER CM-1 ) INTEGER VALUE                     LOW 1050
C     DV= FREQUENCY INTERVALS AT WHICH TRANSMITTANCE IS PRINTED              LOW 1060
C     NOTE  DV MUST BE A MULTIPLE OF 5 CM-1.  WHEN JBMOD=1, DV MUST          LOW*1070
C           BE 5CM-1.  USE THE SLIT FUNCTION TO DEGRADE THE RESULTS.         LOW*1071
C                                                                            LOW 1080
C     IXY=0  TO END DATA ,=1 FOR NEW V1,V2,DV ONLY , =2 TO CONTINUE DATA     LOW 1090
C     IXY=3 FOR NEW CARD 2 ONLY,=4 FOR NEW CARD 1 ONLY.                      LOW 1100
C     MSLT=0 REPEAT PREVIOUS CASE (SKIP CARDS 6 TO 8), =1 NO SLIT FUNCT      LOW:1101
C       (SKIP CARDS 6A,6B), =2 DEGRADE USING THE SLIT FUNCTION               LOW:1102
C     MPRT=0 DON'T PRINT, =1 PRINT TRANS. ONLY, =2 PRINT RADIANCE ONLY,      LOW:1103
C       =3 PRINT TRANS. AND RADIANCE                                         LOW:1104
C     MPLT=0 SKIP PLOTS, =1 PLOT TRANS. VS CM-1, =2 PLOT RADIANCE,           LOW:1105
C       =3 PLOT TRANS. AND RADIANCE, =-1,-2,-3 SAME BUT PLOT VS MICRON       LOW:1106
C     NS=NUMBER OF DEFINING POINTS (XSS,SS) FOR SLIT FUNCTION                LOW:1107
C     WIDTH=WIDTH OF BASE(CM-1); SHIFT=INCREMENT TO NEXT SLIT FCN.           LOW:1108
C     XAXIS=LENGTH OF AXIS(INCHES); (XINIT,XEND)=(FIRST,LAST) X POINTS       LOW:1109
C     DXT=MAJOR TIC MARK INCREMENT                                           LOW:110A
C     NMINX=NO. OF MINOR TICS BETWEEN MAJOR ONES                             LOW:110B
C     YAXIS,YINIT,YEND,DYT,NMINY=DITTO FOR THE Y AXIS.                       LOW:110C
```

```
C     ********************************************************************LOW 1110
C                                                                          LOW:1111
C     ********************** IMPLEMENTATION NOTE **********************LOW:1112
C     LITERAL ASSIGNMENTS WILL HAVE TO BE CHANGED FOR MACHINES THAT      LOW:1113
C     STORE MORE THAN 4 CHARACTERS PER SINGLE PRECISION WORD (UNIVAC     LOW:1114
C     AND CDC).  THE DOUBLE PRECISION VARIABLES AFFECTED ARE:            LOW:1115
C           HZ,SEASN,VULCN,AHOL,AHOL1,AHOL2,AHOL3                        LOW:1116
C     ADDITIONALLY, SOME LITERALS FOR THE PLOT PACKAGE ARE DESCRIBED     LOW:1117
C     AT THE TOP OF SUBROUTINE LIB.                                      LOW:1118
C                                                                        LOW:1119
      DOUBLE PRECISION HZ,SEASN,VULCN                                    LOW:111A
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO   LOW 1120
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                   LOW*1130
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                      LOW 1140
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI                LOW 1150
      COMMON /CARD4/ IXY                                                 LOW*1151
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1  LOW 1160
     1,IFIND,NL,IKLO                                                     LOW 1170
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)             LOW 1180
     * ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        LOW 1190
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                           LOW:1191
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)         LOW 1200
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                  LOW*1210
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                               LOW 1220
C                                                                        LOW:1221
C     SPECIFY PLOT CONTROL PARAMETERS                                    LOW:1222
      MSLTO = 0                                                          LOW:1223
      LPLT = 0                                                           LOW:1223
C                                                                        LOW:1224
      IXY=0                                                              LOW 1230
C     SET UP FILE NUMBERS FOR I/O PROCEDURES                             LOW:1231
C         NTBL (USED BY BMDATA & BMOD) IS DECLARED IN BMDATA.            LOW:1232
C         NSCR (PLOTTING SCRATCH FILE) IS DECLARED IN LIB                LOW:1233
C         NPLTR (PLOTTER FILE NO.) IS DECLARED IN LIB                    LOW:1234
C     TO USE THE NSTOR OUTPUT FILE, REMOVE THE  C  FROM THESE LINES:     LOW:1235
C         LOW 1239,2280-2310,2380  AND  TRA 2330,2420                    LOW:1236
      NIN = 5                                                            LOW:1237
      NOUT = 6                                                           LOW:1238
C     NSTOR = 7                                                          LOW:1239
      NPLT = 9                                                           LOW:123A
C     CALL MDTA                                                          LOW:1240
      KMAX=15                                                            LOW 1250
      PI=2.0*ASIN(1.0)                                                   LOW 1260
      CA=PI/180.                                                         LOW 1270
   10 CONTINUE                                                           LOW 1280
      RE=6371.23                                                         LOW 1290
      IFIND=0                                                            LOW 1300
C     JP NE 0  SUPRESS PRINT                                             LOW 1310
      READ (NIN,105) MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO,  LOW:1320
     1TBOUND,ISEASN,IVULCN,VIS,JBMOD                                     LOW*1330
C     IEMISS=0=TRANSMISSION MODE / IEMISS=1=EMISSION MODE                LOW 1340
      IF (IEMISS.EQ.1) WRITE (NOUT,110)                                  LOW:1350
      IF (IEMISS.EQ.0) WRITE (NOUT,115)                                  LOW:1360
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      IF (JBMOD.EQ.1) WRITE(NOUT,118)                                    LOW*1361
      LENST=LEN                                                          LOW 1370
      WRITE(NOUT,105) MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO LOW:1380
     1,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                    LOW*1390
C     SKIP TO PLOT PACKAGE WHEN MODEL=10                                 LOW:1391
      IF (MODEL.EQ.10) GO TO 77                                          LOW:1392
   15 M=MODEL                                                            LOW 1400
      IF((M.EQ.3.OR.M.EQ.5).AND.ISEASN.EQ.0) ISEASN=2                    LOW 1410
      IF (VIS.LE.0.0.AND.IHAZE.GT.0) VIS=VSB(IHAZE)                      LOW 1420
      ICH(1)=IHAZE                                                       LOW 1430
      ICH(2)=6                                                           LOW 1440
      ICH(3)=9+IVULCN                                                    LOW 1450
      ICH(4)=15                                                          LOW 1460
      IF (ICH(1).LE.0) ICH(1)=1                                          LOW 1470
      IF (ICH(3).LE.9) ICH(3)=10                                         LOW 1480
      IF (MODEL.EQ.1) RE=6378.39                                         LOW 1490
      IF (MODEL.EQ.4) RE=6356.91                                         LOW 1500
      IF (MODEL.EQ.5) RE=6356.91                                         LOW 1510
      IF (IHAZE.NE.7) GO TO 20                                           LOW 1520
      READ (NIN,200) (DUMMY,EXTC(1,I),ABSC(1,I),I=1,40)                  LOW:1530
   20 IF (RO.GT.0.0) RE=RO                                               LOW 1540
      IF (MODEL.EQ.7.AND.IM.NE.0) GO TO 35                               LOW 1550
      IF (IXY.GT.3) GO TO 65                                             LOW 1560
      IF (MODEL.EQ.0) GO TO 35                                           LOW 1570
   25 READ (NIN,120) H1,H2,ANGLE,RANGE,BETA                              LOW:1580
      WRITE (NOUT,185) H1,H2,ANGLE,RANGE,BETA                            LOW:1590
      X1=RE+H1                                                           LOW 1600
      IF (ITYPE.EQ.3) GO TO 40                                           LOW 1610
      IF (ITYPE.EQ.1) GO TO 65                                           LOW 1620
      X2=RE+H2                                                           LOW 1630
      IF (RANGE.EQ.0.) GO TO 50                                          LOW 1640
      WRITE (NOUT,195) H1,H2,ANGLE,RANGE,BETA                            LOW:1650
      IF (H2.EQ.0.0.AND.ANGLE.NE.0.0) GO TO 30                           LOW 1660
      ANGLE=ACOS(0.5*((H2-H1)*(1.+X2/X1)/RANGE-RANGE/X1))/CA             LOW 1670
      GO TO 60                                                           LOW 1680
   30 X2=SQRT((X1/RANGE+RANGE/X1+2.0*COS(ANGLE*CA))*X1*RANGE)            LOW 1690
      H2=X2-RE                                                           LOW 1700
      GO TO 60                                                           LOW 1710
   35 CONTINUE                                                           LOW 1720
      IF (ML.LE.0) ML=1                                                  LOW 1730
      CALL NSMDL                                                         LOW 1740
      IM=0                                                               LOW 1750
      IF (MODEL.EQ.0) GO TO 65                                           LOW 1760
      NL=ML                                                              LOW 1770
C     NOTE THAT Z(I) MAY NOT CORRESPOND TO THE VALUES GIVEN FOR STANDARD LOW 1780
C     MODEL ATMOSPHERES                                                  LOW 1790
      IF (IXY.GT.3) GO TO 65                                             LOW 1800
      GO TO 25                                                           LOW 1810
   40 IF (RANGE.GT.0.0) GO TO 45                                         LOW 1820
      IF (H2.GT.0.0.AND.H2.LT.H1) IFIND=1                                LOW 1830
      GO TO 65                                                           LOW 1840
   45 ITYPE=2                                                            LOW 1850
      BETA=ACOS(0.5*(RANGE*RANGE/(X1*X2)-X2/X1-X1/X2))/CA                LOW 1860
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   50 IF (BETA.EQ.0.) GO TO 55                                                    LOW 1870
      IFIND=1                                                                     LOW 1880
      BET=CA*BETA                                                                 LOW 1890
      X2=RE+H2                                                                    LOW 1900
      ANGLE=ATAN(X2*SIN(BET)/(X2*COS(BET)-X1))/CA                                 LOW 1910
      RANGE=X2*SIN(BET)/SIN(ANGLE*CA)                                             LOW 1920
      BET=BETA                                                                    LOW 1930
      GO TO 65                                                                    LOW 1940
   55 RANGE=(X2/X1)**2-(SIN(ANGLE*CA))**2                                         LOW 1950
      IF (RANGE.GE.0.0) RANGE=X1*(SQRT(RANGE)-ABS(COS(ANGLE*CA)))                 LOW 1960
   60 IF (ANGLE.NE.0..OR.ANGLE.NE.180.) BET=ASIN(RANGE*SIN(ANGLE*CA)/X2)LOW 1970
      IF(ANGLE.LT.0.) ANGLE=ANGLE+180.                                            LOW 1980
      IF (RANGE.LT.0.0) RANGE=-RANGE                                              LOW 1990
      BET=BET/CA                                                                  LOW 2000
      WRITE (NOUT,195) H1,H2,ANGLE,RANGE,BET                                      LOW:2010
   65 CONTINUE                                                                    LOW 2020
      IF (IXY.LE.2) READ (NIN,120) V1,V2,DV                                       LOW:2030
      IF (IXY.LE.2) WRITE (NOUT,120) V1,V2,DV                                     LOW:2040
      IF (ITYPE.EQ.1) WRITE (NOUT,125) H1,RANGE                                   LOW:2050
      IF (ITYPE.EQ.2) WRITE (NOUT,130) H1,H2,ANGLE                                LOW:2060
      IF (ITYPE.EQ.3) WRITE (NOUT,135) H1,ANGLE                                   LOW:2070
      IF (MODEL.EQ.0) M=7                                                         LOW 2080
      IF (VIS.GT.0.0) WRITE (NOUT,175) VIS                                        LOW:2090
      IF (M.EQ.1) WRITE (NOUT,140) MODEL                                          LOW:2100
      IF (M.EQ.2) WRITE (NOUT,145) MODEL                                          LOW:2110
      IF (M.EQ.3) WRITE (NOUT,150) MODEL                                          LOW:2120
      IF (M.EQ.4) WRITE (NOUT,155) MODEL                                          LOW:2130
      IF (M.EQ.5) WRITE (NOUT,165) MODEL                                          LOW:2140
      IF (M.EQ.6) WRITE (NOUT,160) MODEL                                          LOW:2150
      IF (IHAZE.EQ.0) WRITE (NOUT,190)                                            LOW:2160
      IF (IHAZE.NE.0) WRITE (NOUT,170) IHAZE,HZ(IHAZE),VIS                        LOW:2170
      IF (ISEASN.EQ.0) WRITE (NOUT,205) SEASN(1)                                  LOW:2180
      IF (ISEASN.NE.0) WRITE (NOUT,205) SEASN(ISEASN)                             LOW:2190
      IF (IVULCN.EQ.0) WRITE (NOUT,210) VULCN(1)                                  LOW:2200
      IF (IVULCN.NE.0) WRITE (NOUT,210) VULCN(IVULCN)                             LOW:2210
      AVW=10000./V1                                                               LOW:2220
      ALAM=10000./V2                                                              LOW 2230
      WRITE (NOUT,180) V1,V2,DV,ALAM,AVW                                          LOW:2240
      CALL HPROF                                                                  LOW 2250
      CALL GEO                                                                    LOW 2260
      CALL EXABIN                                                                 LOW 2270
   70 CONTINUE                                                                    LOW*2271
C     CHECK THAT DV = 5 CM-1 WHEN JBMOD = 1                                       LOW*2272
      IF ((JBMOD.EQ.0) .OR. (DV.EQ.5.0)) GO TO 72                                 LOW*2272
      WRITE (NOUT,225)DV                                                          LOW*2274
      STOP                                                                        LOW*2275
   72 CONTINUE                                                                    LOW*2276
C     WRITE(NSTOR,105)MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO,LOW:2280
C    1 TBOUND,ISEASN,IVULCN,VIS,JBMOD                                            LOW*2290
C     WRITE(NSTOR,120) H1,H2,ANGLE,RANGE,BETA                                     LOW:2300
C     WRITE(NSTOR,120)V1,V2,DV                                                    LOW:2310
      IF ((IEMISS.EQ.0) .AND. (JBMOD.EQ.0)) GO TO 75                              LOW*2320
      CALL PATH                                                                   LOW 2330
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      IF (IEMISS.EQ.0) GO TO 75                                          LOW*2331
      WRITE (NOUT,215)                                                   LOW:2340
      WRITE (NOUT,220)                                                   LOW:2350
   75 CALL TRANS                                                         LOW 2360
   77 READ (NIN,105) IXY                                                 LOW:2370
C     CALL PLOT SUBROUTINES                                              LOW:2371
      CALL LIB(MSLTO,LPLT)                                               LOW:2372
C     END FILE NSTOR                                                     LOW:2380
      JEXTRA=0                                                           LOW 2390
      IFIND=0                                                            LOW 2400
      WRITE (NOUT,105) IXY                                               LOW:2410
      IF (IXY.EQ.0) GO TO 95                                             LOW 2420
      GO TO (80,10,85,10,95), IXY                                        LOW 2430
   80 READ (NIN,120) V1,V2,DV                                            LOW:2440
      AVW=10000./V1                                                      LOW 2450
      ALAM=10000./V2                                                     LOW 2460
      WRITE (NOUT,180) V1,V2,DV,ALAM,AVW                                 LOW:2470
      GO TO 70                                                           LOW 2480
   85 IF (IEMISS.EQ.1) WRITE (NOUT,110)                                  LOW:2490
      IF (IEMISS.EQ.0) WRITE (NOUT,115)                                  LOW:2500
      IF (MODEL.EQ.0) GO TO 35                                           LOW 2510
      GO TO 25                                                           LOW 2520
   95 STOP                                                               LOW 2530
C                                                                        LOW 2540
  100 FORMAT (3I3,6F11.4)                                                LOW 2550
  105 FORMAT (11I3,2F10.3,2I3,F11.3,I2)                                  LOW*2560
  110 FORMAT (47H1 PROGRAM WILL BE EXECUTED IN THE EMISSION MODE)        LOW 2570
  115 FORMAT (51H1 PROGRAM WILL BE EXECUTED IN THE TRANSMISSION MODE)    LOW 2580
  118 FORMAT (41H THE 5CM-1 BAND MODEL OPTION WILL BE USED)              LOW*2581
  120 FORMAT (7F10.3)                                                    LOW 2590
  125 FORMAT (//10X,28H HORIZONTAL PATH, ALTITUDE =,F7.3,11H KM,RANGE =,LOW 2600
     1F7.3,3H KM)                                                        LOW 2610
  130 FORMAT (//10X,50H SLANT PATH BETWEEN ALTITUDES H1 AND H2 WHERE H1 LOW 2620
     1=,F7.3,8H KM H2 =,F7.3,18H KM,ZENITH ANGLE =,F7.3,8H DEGREES)      LOW 2630
  135 FORMAT (//10X,39H SLANT PATH TO SPACE FROM ALTITUDE H1 =,F7.3,19H LOW 2640
     1KM, ZENITH ANGLE =,F7.3,8H DEGREES)                                LOW 2650
  140 FORMAT (/20X,18H MODEL ATMOSPHERE ,I1,11H = TROPICAL)              LOW 2660
  145 FORMAT (/20X,18H MODEL ATMOSPHERE ,I1,21H = MIDLATITUDE SUMMER)    LOW 2670
  150 FORMAT (/20X,18H MODEL ATMOSPHERE ,I1,21H = MIDLATITUDE WINTER)    LOW 2680
  155 FORMAT (/20X,18H MODEL ATMOSPHERE ,I1,21H = SUB-ARCTIC SUMMER )    LOW 2690
  160 FORMAT (/20X,18H MODEL ATMOSPHERE ,I1,21H = 1962 US STANDARD  )    LOW 2700
  165 FORMAT (/20X,18H MODEL ATMOSPHERE ,I1,21H = SUB-ARCTIC WINTER )    LOW 2710
  170 FORMAT (/20X,15H   HAZE MODEL  ,I1,3H = ,A10,8H    VIS=,F5.1,2HKM)LOW 2720
  175 FORMAT (/25X,13HHAZE MODEL  =,F5.1,29H KM VISUAL RANGE AT SEA LEVELOW 2730
     1L)                                                                 LOW 2740
  180 FORMAT (/10X,21H FREQUENCY RANGE V1= ,F7.1,13H CM-1 TO V2= ,F7.1,1LOW 2750
     14H CM-1 FOR DV =,F6.1,9H CM-1   (,F6.2,3H - ,F5.2,10H MICRONS ))  LOW 2760
  185 FORMAT (10X,7F10.3)                                                LOW 2770
  190 FORMAT (/20X,39HAEROSOL SCATTERING NOT COMPUTED,IHAZE=0)           LOW 2780
  195 FORMAT (10X,4H H1=,F7.3,6HKM,H2=,F7.3,9HKM,ANGLE=,F8.4,13HGEOM. RALOW 2790
     1NGE =,F7.2,8HKM,BETA=,F8.5)                                        LOW 2800
  200 FORMAT (4(F6.2,2F7.5))                                             LOW 2810
  205 FORMAT (/20X,10H SEASON = ,A13)                                    LOW 2820
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210 FORMAT (/20X,34H VERTICAL PROFILE AEROSOL MODEL = ,A16)                LOW 2830
215 FORMAT (1H1,50X,28HRADIANCE(WATTS/CM2-STER-XXX))                      LOW 2840
220 FORMAT (30X,47HFR(CM-1)  WVL(MICRON)     PER CM-1   PER MICRON,26HLOW 2850
   1     INTEGRAL         TRANS)                                         LOW 2860
225 FORMAT (20X,10(1H*),2X,38HWHEN USING BAND MODEL OPTION (JBMOD=1)  LOW*2861
   1  20H, DV MUST BE 5.0!!  ,10(1H*)//20X,6HDV  = ,F6.1,               LOW*2862
   2  27H---THEREFORE PROGRAM STOPS!)                                   LOW*2863
    END                                                                  LOW 2870
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      SUBROUTINE NSMDL                                                  NSM   10
C                                                                       NSM   20
C     USED FOR USER DEFINED ATMOSPHERIC MODELS (MODEL=0 OR 7)           NSM   30
C     DEFINES ALTITUDE DEPENDENT VARIABLES Z,P,T,WH,WO AND HAZE         NSM   40
C     LOADS HAZE INTO APPROPRATE EH LOCATION                            NSM   50
C                                                                       NSM   60
      DOUBLE PRECISION HZ,SEASN,VULCN,AHOL,AHOL1,AHOL2,AHOL3            NSM  :61
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO  NSM   70
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                  NSM  *80
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                     NSM   90
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI               NSM  100
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1 NSM  110
     1,IFIND,NL,IKLO                                                    NSM  120
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            NSM  130
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        NSM  140
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          NSM :141
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        NSM  150
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 NSM *160
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                              NSM  170
      F(A)=EXP(18.9766-14.9595*A-2.43882*A*A)*A                         NSM  180
      RV=4.6150E-3                                                      NSM  190
      TO=273.15                                                         NSM  200
      IC1=1                                                             NSM  210
      N=7                                                               NSM  220
      IF(IVULCN.LE.0) IVULCN=1                                          NSM  230
      IF(ISEASN.LE.0) ISEASN=1                                          NSM  240
C     FOR MODEL EQ ZERO                                                 NSM  250
      IHA1=0                                                            NSM  260
      ISEA1=0                                                           NSM  270
      IVUL1=0                                                           NSM  280
      VIS1=0.                                                           NSM  290
      AHAZE=0.                                                          NSM  300
C       END OF MODEL ZERO DEFAULT                                       NSM  310
      IF (M.NE.0) WRITE (NOUT,100)                                      NSM :320
      DO 65 K=1,ML                                                      NSM  330
      AHOL= 8H                                                          NSM :340
      AHOL1= 8H                                                         NSM :350
      AHOL2= 8H                                                         NSM :360
      AHOL3= 8H                                                         NSM :370
      IF(M.EQ.0) READ(NIN,85) H1,P(7,1),TMP,DP,RH,WH(7,K),WO(7,K),RANGE NSM :380
      IF(M.EQ.0)WRITE(NOUT,90) H1,P(7,1),TMP,DP,RH,WH(7,K),WO(7,K),RANGENSM :390
      IF (M.GT.0) READ (NIN,80) Z(K),P(7,K),TMP,DP,RH,WH(7,K),WO(7,K),  NSM :400
     1    VIS1,IHA1,ISEA1,IVUL1                                         NSM :410
      IF (M.EQ.0) Z(K)=H1                                               NSM  420
      WRITE (NOUT,95) Z(K),P(7,K),TMP,DP,RH,WH(7,K),WO(7,K),AHAZE,VIS1, NSM :430
     1    IHA1,ISEA1,IVUL1                                              NSM :440
C     IHA1  IS IHAZE FOR THIS LAYER                                     NSM  450
C     ISEA1 IS ISEASN FOR THIS LAYER                                    NSM  460
C     IVUL1 IS IVULCN FOR THE LAYER                                     NSM  470
      IF(ISEA1.EQ.0) ISEA1=ISEASN                                       NSM  480
      IF(IHA1.GT.0.OR.IVUL1.GT.0) GO TO 10                              NSM  490
      ITYAER=IHAZE                                                      NSM  500
      IF (Z(K).GT.2.0) ITYAER=6                                         NSM  510
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      IF (Z(K).GT.9.0) ITYAER=IVULCN+9                                  NSM  520
      IF (Z(K).GT.30.) ITYAER=15                                        NSM  530
      IHA1=IHAZE                                                        NSM  540
      IVUL1=IVULCN                                                      NSM  550
      GO TO 15                                                          NSM  560
10    IF(IVUL1.GT.0)ITYAER=IVUL1+9                                      NSM  570
      IF(IHA1.GT.0) ITYAER=IHA1                                         NSM  580
      IF(ITYAER.GT.15) ITYAER=15                                        NSM  590
      IF(IHA1.LE.0) IHA1=IHAZE                                          NSM  600
      IF(IVUL1.LE.0) IVUL1=IVULCN                                       NSM  610
   15 IF (K.EQ.1) GO TO 20                                              NSM  620
      IF(N.EQ.7.AND.ITYAER.EQ.6.AND.Z(K).GT.2.0) GO TO 17               NSM  630
      IF (ITYAER.EQ.ICH(IC1)) GO TO 20                                  NSM  640
17    IC1=IC1+1                                                         NSM  650
      N=IC1+10                                                          NSM  660
      IF (IC1.LE.4) GO TO 20                                            NSM  670
      IC1=4                                                             NSM  680
      N=14                                                              NSM  690
      ITYAER=ICH(IC1)                                                   NSM  700
   20 ICH(IC1)=ITYAER                                                   NSM  710
      J=IFIX(Z(K)+1.0E-6)+1                                             NSM  720
      IF (Z(K).GE.25.0) J=(Z(K)-25.0)/5.0+26.                           NSM  730
      IF (Z(K).GE.50.0) J=(Z(K)-50.0)/20.0+31.                          NSM  740
      IF (Z(K).GE.70.0) J=(Z(K)-70.0)/30.0+32.                          NSM  750
      IF (J.GT.33) J=33                                                 NSM  760
      FAC=Z(K)-FLOAT(J-1)                                               NSM  770
      IF (J.LT.26) GO TO 25                                             NSM  780
      FAC=(Z(K)-5.0*FLOAT(J-26)-25.)/5.                                 NSM  790
      IF (J.GE.31) FAC=(Z(K)-50.0)/20.                                  NSM  800
      IF (J.GE.32) FAC=(Z(K)-70.0)/30.                                  NSM  810
      IF (FAC.GT.1.0) FAC=1.0                                           NSM  820
   25 L=J+1                                                             NSM  830
      T(7,K)=TMP+TO                                                     NSM  840
      IF (M1.GT.0) P(7,K)=P(M1,J)*(P(M1,L)/P(M1,J))**FAC                NSM  850
      IF (M1.GT.0) T(7,K)=T(M1,J)*(T(M1,L)/T(M1,J))**FAC                NSM  860
      IF (M2.GT.0) WH(7,K)=WH(M2,J)*(WH(M2,L)/WH(M2,J))**FAC            NSM  870
      IF (WH(7,K).GT.0.0) GO TO 35                                      NSM  880
      IF (RH.GT.0.0) GO TO 30                                           NSM  890
      DPK=TO+DP                                                         NSM  900
      TT=TO/DPK                                                         NSM  910
      WH(7,K)=DPK*F(TT)/T(7,K)                                          NSM  920
      GO TO 35                                                          NSM  930
   30 TA=TO/T(7,K)                                                      NSM  940
      RHSAT=F(TA)                                                       NSM  950
      RHD=.01*RH                                                        NSM  960
      DN=(1.0-(1.0-RHD)*RHSAT*RV*T(7,K)/P(7,K))                         NSM  970
      WH(7,K)=RHSAT*RHD/DN                                              NSM  980
   35 CONTINUE                                                          NSM  990
      IF (M3.GT.0) WO(7,K)=WO(M3,J)*(WO(M3,L)/WO(M3,J))**FAC            NSM 1000
      HSTOR(K)=0.                                                       NSM 1010
      IF (HMIX(J).LE.0.) GO TO 40                                       NSM 1020
      IF (HMIX(L).LE.0.) GO TO 40                                       NSM 1030
      HSTOR(K)=HMIX(J)*(HMIX(L)/HMIX(J))**FAC                           NSM 1040
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   40 CONTINUE                                                          NSM 1050
      EH(7,K)=0.                                                        NSM 1060
      EH(12,K)=0.                                                       NSM 1070
      EH(13,K)=0.                                                       NSM 1080
      EH(14,K)=0.                                                       NSM 1090
      EH(15,K)=0.                                                       NSM 1100
      IF(IHAZE.EQ.0) GO TO 60                                           NSM 1110
      IF (VIS1.LE.0.0) VIS1=VIS                                         NSM 1120
      IF (AHAZE.EQ.0.0) GO TO 45                                        NSM 1130
      EH(N,K)=AHAZE                                                     NSM 1140
C     AHAZE IS IN LOWTRAN NUMBER DENSITY UNITS                          NSM 1150
      GO TO 55                                                          NSM 1160
   45 CALL AERPRF (J,VIS1,HAZ1,IHA1,ISEA1,IVUL1,NN)                     NSM 1170
      CALL AERPRF (L,VIS1,HAZ2,IHA1,ISEA1,IVUL1,NN)                     NSM 1180
      HAZE=0.                                                           NSM 1190
      IF ((HAZ1.LE.0.0).OR.(HAZ2.LE.0.0)) GO TO 50                      NSM 1200
      HAZE=HAZ1*(HAZ2/HAZ1)**FAC                                        NSM 1210
   50 EH(N,K)=HAZE                                                      NSM 1220
   55 AHOL=HZ(ITYAER)                                                   NSM 1230
      IF (AHAZE.NE.0.) GO TO 60                                         NSM 1240
      IF (Z(K).LE.2.0) AHOL1=HZ(IHA1)                                   NSM 1250
      IF ((Z(K).GT.2.0).AND.(Z(K).LE.30.)) AHOL2=SEASN(ISEA1)           NSM 1260
      IF (Z(K).GT.9.0) AHOL3=VULCN(IVUL1)                               NSM 1270
   60 WRITE (NOUT,95) Z(K),P(7,K),T(7,K),DP,RH,WH(7,K),WO(7,K),EH(N,K), NSM:1280
     1    VIS1,IHA1,ISEA1,IVUL1,ITYAER,AHOL1,AHOL2,AHOL3,AHOL           NSM:1290
   65 CONTINUE                                                          NSM 1300
      IF (IC1.LT.4) GO TO 75                                            NSM 1310
      IC2=IC1+1                                                         NSM 1320
      DO 70 K=IC2,4                                                     NSM 1330
   70 ICH(K)=ICH(K-1)                                                   NSM 1340
   75 CONTINUE                                                          NSM 1350
      RETURN                                                            NSM 1360
C                                                                       NSM 1370
   80 FORMAT (3F10.3,2F5.1,2E10.3,E10.3,F7.3,3I1)                       NSM 1380
   85 FORMAT (3F10.3,2F5.1,2E10.3,2F10.3)                               NSM 1390
   90 FORMAT (10X,26HINPUT METEOROLOGICAL DATA\/10X,2HZ=,F7.2,7H KM, P=,NSM 1400
     1F7.2,6H MB,T=,F5.1,15H C, DEW PT.TEMP,F5.1,17H C, REL HUMIDITY=,F5NSM 1410
     2.1,16H %, H2O DENSITY=,1PE9.2,7H GM M-3/10X,15H OZONE DENSITY=,E9.NSM 1420
     32,16H GM M-3,  PANGE=,0PF10.3,4H KM )                             NSM 1430
   95 FORMAT (3F10.3,2F5.1,3E10.3,F10.3,4I3,4(1X,A10))                  NSM 1440
  100 FORMAT (24H  MODEL ATMOSPHERE NO. 7,/4X,6HZ (KM),3X,6HP (MB),4X,49NSM 1450
     1HT (C) DEW PT %RH  H2O(GM.M-3) O3(GM.M-3) NO. DEN.,30X,15HAEPOSOL NSM 1460
     2PROFILE,6X,10HEXTINCTION)                                         NSM 1470
      END                                                               NSM 1480
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      SUBROUTINE HPROF                                                    HPR   10
C       MODIFIED FOR 5 CM-1 BAND MODEL OPTION --- OCTOBER 1980            HPR  *11
C                                          REVISED 12 DEC 1979            HPR   20
C     DEFINES THE ATMOSPHERIC DENSITY PROFILE OF THE MOLECULAR AND        HPR   30
C        AEROSOL AMOUNTS FOR THE MODEL SELECTED                           HPR   40
C                                                                         HPR   50
      DOUBLE PRECISION HZ,SEASN,VULCN                                     HPR  :51
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO    HPR   60
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                    HPR  *70
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                       HPR   80
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI                 HPR   90
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1   HPR  100
     1,IFIND,NL,IKLO                                                      HPR  110
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)              HPR  120
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                          HPR  130
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                            HPR  :131
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)          HPR  140
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                   HPR  *150
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                                HPR  160
      F(A)=EXP(18.9766-14.9595*A-2.43882*A*A)*A                           HPR  170
      DO 5 I=1,34                                                         HPR  180
      DO 5 J=1,KMAX                                                       HPR  190
    5 WLAY(I,J)=0.                                                        HPR  200
C      RV = H2O GAS CONSTANT                                              HPR  210
      AVW=0.5E-4*(V1+V2)                                                  HPR  220
      AVW=AVW*AVW                                                         HPR  230
      CO=77.46+.459*AVW                                                   HPR  240
      CW=43.487-0.3473*AVW                                                HPR  250
C     CHANGE FOR BLACKBODY SOURCE AT ANY H2 (SEE TRANS--LINE TRA:2181)    HPR  :251
C     IF(TBOUND.LE.0.AND.(M1.LE.0.OR.M.EQ.7))TBOUND=T(M,1)                HPR  :260
C     IF(TBOUND.LE.0.AND.M1.GT.0.AND.M.LT.7) TBOUND=T(M1,1)               HPR  :270
      IF (JP.EQ.0) WRITE (NOUT,45)                                        HPR  :280
      IF (JP.EQ.0) WRITE (NOUT,50)                                        HPR  :290
      IF (M.LT.7) ML=NL                                                   HPR  300
      RV=4.6150E-3                                                        HPR  310
      DO 25 I=1,ML                                                        HPR  320
      PS=P(M,I)/1013.0                                                    HPR  330
      TS=273.15/T(M,I)                                                    HPR  340
      WTEMP=WH(M,I)                                                       HPR  350
      IF(M1.GT.0.AND.M.LT.7)PS=P(M1,I)/1013.                              HPR  360
      IF(M1.GT.0.AND.M.LT.7) TS=273.15/T(M1,I)                            HPR  370
      IF(M2.GT.0.AND.M.LT.7) WTEMP=WH(M2,I)                               HPR  380
      RELHUM(I)=0.                                                        HPR  390
      IF (Z(I).GT.2.0) GO TO 10                                           HPR  400
      RHOSTR=(PS*1013.0)*(TS/273.15)/RV                                   HPR  410
      RELHUM(I)=100.0*(WTEMP/F(TS))*((RHOSTR-F(TS))/  (RHOSTR-WTEMP))     HPR  420
   10 D=0.1*WTEMP                                                         HPR  430
      X=PS*TS                                                             HPR  440
      PT=PS*SQRT(TS)                                                      HPR  450
      EH(1,I)=D*PT**0.9                                                   HPR  460
      EH(2,I)=X*PT**0.75                                                  HPR  470
      EH(4,I)=0.8*PT*X                                                    HPR  480
      PPW=4.56E-5*D*273.15/TS                                             HPR  490
      TS1=(296.0/273.15)*TS                                               HPR  500
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      EH(5,I)=D*PPW*EXP(6.08*(TS1-1.0))+0.002*D*(PS-PPW)                    HPR  510
      EH(10,I)=D*(PPW+0.12*(PS-PPW))*EXP(4.56*(TS1-1.0))                   HPR  520
      EH(6,I)=X                                                            HPR  530
C     SUBROUTINE AERPRF COMPUTES EH(7,I)                                   HPR  540
C     EH(7,I)=AERSOL FOR 0-2KM                                             HPR  550
C     EH(12,I)=AERSOL FOR 2-9KM                                            HPR  560
C     EH(13,I)=AERSOL FOR 9-30KM                                           HPR  570
C     EH(14,I)=AERSOL FOR 30-100KM                                         HPR  580
      IF (M.NE.7) CALL AERPRF (I,VIS,HAZE,IHAZE,ISEASN,IVULCN,N)           HPR  590
      IF (M.EQ.7) GO TO 15                                                 HPR  600
      EH(7,I)=0.                                                           HPR  610
      EH(12,I)=0.                                                          HPR  620
      EH(13,I)=0.                                                          HPR  630
      EH(14,I)=0.                                                          HPR  640
      EH(15,I)=0.                                                          HPR  650
      EH(N,I)=HAZE                                                         HPR  660
   15 CONTINUE                                                             HPR  670
      EH(15,I)=RELHUM(I)*EH(7,I)                                           HPR  680
      IF(ICH(1).GT.7)EH(15,I)=RELHUM(I)*EH(12,I)                           HPR  690
      EH(8,I)=46.6667*WO(M,I)                                              HPR  700
      IF (M3.GT.0.AND.M.LT.7) EH(8,I)=46.667*WO(M3,I)                      HPR  710
      EH(3,I)=EH(8,I)*PT**0.4                                              HPR  720
C     EH(11,I)=HNO3 ABSORBER AMOUNT (ATM-CM)/KM                            HPR  730
      EH(11,I)=PS*TS*HMIX(I)*1.0E-04                                       HPR  740
C                                                                          HPR *741
C     SWITCH FOR 5CM-1 BAND MODEL OPTION                                   HPR *742
      IF (JBMOD.EQ.0) GO TO 18                                             HPR *743
      EH(1,I) = D                                                          HPR *744
      EH(2,I) = X                                                          HPR *745
      EH(3,I) = EH(8,I)                                                    HPR *746
   18 CONTINUE                                                             HPR *747
C                                                                          HPR *748
      IF (M.EQ.7) EH(11,I)=PS*TS*HSTOR(I)*1.0E-04                          HPR  750
      EH(9,I)=1.0                                                          HPR  760
      REF=1.0E-6*(CO*X*1013.0/273.15-PPW*CW)                               HPR  770
      IF (I.EQ.ML) GO TO 20                                                HPR  780
      P2=P(M,I+1)                                                          HPR  790
      T2=T(M,I+1)                                                          HPR  800
      W2=WH(M,I+1)                                                         HPR  810
      IF(M1.GT.0.AND.M.LT.7) P2=P(M1,I+1)                                  HPR  820
      IF (M1.GT.0.AND.M.LT.7) T2=T(M1,I+1)                                 HPR  830
      IF (M2.GT.0.AND.M.LT.7) W2=WH(M2,I+1)                                HPR  840
      PPW=4.56E-6*W2*T2                                                    HPR  850
      EH(9,I)=0.5*(REF+1.0E-6*(CO*P2/T2-PPW*CW))                           HPR  860
   20 IF (I.EQ.ML) EH(9,I)=0.                                              HPR  870
      IF (JP.NE.0) GO TO 25                                                HPR  880
      P1=P(M,I)                                                            HPR  890
      T1=T(M,I)                                                            HPR  900
      IF(M1.GT.0.AND.M.LT.7) P1=P(M1,I)                                    HPR  910
      IF(M1.GT.0.AND.M.LT.7) T1=T(M1,I)                                    HPR  920
      WRITE (NOUT,40) I,Z(I),P1,T1,(EH(K,I),K=1,6),EH(9,I),EH(8,I)         HPR :930
   25 CONTINUE                                                             HPR  940
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      IF(JP.EQ.0) WRITE (NOUT,55)                                          HPR :950
      DO 35 I=1,ML                                                         HPR  960
      IF (JP.NE.0) GO TO 30                                                HPR  970
      P1=P(M,I)                                                            HPR  980
      T1=T(M,I)                                                            HPR  990
      IF(M1.GT.0.AND.M.LT.7) P1=P(M1,I)                                    HPR 1000
      IF(M1.GT.0.AND.M.LT.7) T1=T(M1,I)                                    HPR 1010
      WRITE (NOUT,40) I,Z(I),P1,T1,(EH(K,I),K=10,11),EH(7,I),(EH(K,I),     HPR:1020
     1    K=12,15),RELHUM(I)                                               HPR:1030
   30 EH(9,I)=EH(9,I)+1.                                                   HPR 1040
   35 CONTINUE                                                             HPR 1050
      RETURN                                                               HPR 1060
C                                                                          HPR 1070
   40 FORMAT (I4,0PF9.2,F9.3,F9.3,1X,1P8E10.3)                             HPR 1080
   45 FORMAT (1H1,///10X,20H HORIZONTAL PROFILES/)                         HPR 1090
   50 FORMAT (4H  ID,5X,3HALT,6X,1HP,8X,1HT,8X,3HH2O,6X,4HCO2+,8X,2HO3,8HPR 1100
     1X,2HN2,5X,8HH2O(10M),4X,4HMOLS,5X,5H(N-1),4X,6HO3(UV))               HPR 1110
   55 FORMAT (1H1,///10X,20H HORIZONTAL PROFILES/,4H  ID,5X,3HALT,6X,1HPHPR 1120
     1,8X,1HT,6X,7HH2O(4M),5X,4HHNO3,6X,4HAER1,6X,4HAER2,6X,4HAER3,6X,4HHPR 1130
     2AER4,3X,9H(AER1*RH),5X,2HRH)                                         HPR 1140
      END                                                                  HPR 1150
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      SUBROUTINE AERPRF (I,VIS,HAZE,IHAZE,ISEASN,IVULCN,N)                AER   10
C     WILL COMPUTE HORIZONTAL PROFILES FOR AEROSOLS                       AER   20
      COMMON/PRFDTA/ZHT(34),HZ2K(34,5),FAWI50(34),FAWI23(34),SPSU50(34),AER   30
     1SPSU23(34),BASTFW(34),VUMOFW(34),HIVUFW(34),EXVUFW(34),BASTSS(34),AER   40
     2VUMOSS(34),HIVUSS(34),EXVUSS(34),UPNATM(34),VUTONO(34),            AER   50
     3VUTOEX(34),EXUPAT(34)                                              AER   60
      DIMENSION VS(5)                                                     AER   70
      DATA VS/50.,23.,10.,5.,2./                                          AER   80
      HAZE=0.                                                             AER   90
C     CALL PRFDTA                                                         AER  100
      N=7                                                                 AER  110
      IF (IHAZE.EQ.0) RETURN                                              AER  120
      IF (ZHT(I).GT.2.0) GO TO 15                                         AER  130
      DO 5 J=2,5                                                          AER  140
      IF (VIS.GE.VS(J)) GO TO 10                                          AER  150
    5 CONTINUE                                                            AER  160
      J=5                                                                 AER  170
   10 CONST=1./(1./VS(J)-1./VS(J-1))                                      AER  180
      HAZE=CONST*((HZ2K(I,J)-HZ2K(I,J-1))/VIS+HZ2K(I,J-1)/VS(J)-HZ2K(I,JAER  190
     1)/VS(J-1))                                                          AER  200
      RETURN                                                              AER  210
   15 IF (ZHT(I).GT.9.0) GO TO 35                                         AER  220
      N=12                                                                AER  230
      CONST=1./(1./23.-1./50.)                                            AER  240
      IF (ISEASN.GT.1) GO TO 25                                           AER  250
      IF (VIS.LE.23.) HAZE=SPSU23(I)                                      AER  260
      IF (VIS.LE.23.) RETURN                                              AER  270
      IF (ZHT(I).GT.4.0) GO TO 20                                         AER  280
      HAZE=CONST*((SPSU23(I)-SPSU50(I))/VIS+SPSU50(I)/23.-SPSU23(I)/50.)AER  290
      RETURN                                                              AER  300
   20 HAZE=SPSU50(I)                                                      AER  310
      RETURN                                                              AER  320
   25 IF (VIS.LE.23.) HAZE=FAWI23(I)                                      AER  330
      IF (VIS.LE.23.) RETURN                                              AER  340
      IF (ZHT(I).GT.4.0) GO TO 30                                         AER  350
      HAZE=CONST*((FAWI23(I)-FAWI50(I))/VIS+FAWI50(I)/23.-FAWI23(I)/50.)AER  360
      RETURN                                                              AER  370
   30 HAZE=FAWI50(I)                                                      AER  380
      RETURN                                                              AER  390
   35 IF (ZHT(I).GT.30.0) GO TO 75                                        AER  400
      N=13                                                                AER  410
      HAZE=BASTSS(I)                                                      AER  420
      IF (ISEASN.GT.1) GO TO 55                                           AER  430
      IF (IVULCN.EQ.0) HAZE=BASTSS(I)                                     AER  440
      IF (IVULCN.EQ.0) RETURN                                             AER  450
      GO TO (40,45,50,50,45), IVULCN                                      AER  460
   40 HAZE=BASTSS(I)                                                      AER  470
      RETURN                                                              AER  480
   45 HAZE=VUMOSS(I)                                                      AER  490
      RETURN                                                              AER  500
   50 HAZE=HIVUSS(I)                                                      AER  510
      RETURN                                                              AER  520
   55 IF (IVULCN.EQ.0) HAZE=BASTFW(I)                                     AER  530
      IF (IVULCN.EQ.0) RETURN                                             AER  540
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      GO TO (60,65,70,70,65), IVULCN                                    AER  550
   60 HAZE=BASTFW(I)                                                    AER  560
      RETURN                                                            AER  570
   65 HAZE=VUMOFW(I)                                                    AER  580
      RETURN                                                            AER  590
   70 HAZE=HIVUFW(I)                                                    AER  600
      RETURN                                                            AER  610
   75 N=14                                                              AER  620
      IF (IVULCN.GT.1) GO TO 80                                         AER  630
      HAZE=UPNATM(I)                                                    AER  640
      RETURN                                                            AER  650
   80 HAZE=VUTONO(I)                                                    AER  660
      RETURN                                                            AER  670
      END                                                               AER  680
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      SUBROUTINE GEO                                                    GEO   10
C                                                                       GEO   20
C     SPHERICAL GEOMETRY WITH REFRACTION                                GEO   30
C     DEFINES ABSORBER AMOUNTS FOR THE ATMOSPHERIC SLANT PATH           GEO   40
C     USED TO SET UP VERTICAL PROFILE ARRAY VH AND DEFINES MATRIX       GEO   50
C     WLAY, FOR USE IN SUBROUTINE PATH                                  GEO   60
C                                                                       GEO   70
      DOUBLE PRECISION HZ,SEASN,VULCN                                   GEO  :71
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO  GEO   80
     1 ,IBOUND,ISEASN,IVULCN,VIS,JBMOD                                  GEO  *90
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                     GEO  100
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI               GEO  110
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1 GEO  120
     1,IFIND,NL,IKLO                                                    GEO  130
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            GEO  140
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        GEO  150
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          GEO  :151
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        GEO  160
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 GEO  *170
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                              GEO  180
      JSTOR=0                                                           GEO  190
      JEXTRA=0                                                          GEO  200
      IF (IFIND.EQ.1) CALL ANGL (H1,H2,ANGLE,BETA,LENST,M,NL,RE,PI,ML)  GEO  210
      IFIND=0                                                           GEO  220
      LEN=LENST                                                         GEO  230
      IF (ITYPE.EQ.1) GO TO 20                                          GEO  240
      DO 5 K=1,KMAX                                                     GEO  250
      VH(K)=0.0                                                         GEO  260
    5 CONTINUE                                                          GEO  270
      BETA=0.0                                                          GEO  280
      SR=0.0                                                            GEO  290
      IP=0                                                              GEO  300
C      NOW DEFINE CONSTANT PRESSURE PATH QUANTITES  EH(1-8)             GEO  310
      Y=CA*ANGLE                                                        GEO  320
      SPHI=SIN(Y)                                                       GEO  330
      R1=(RE+H1)*SPHI                                                   GEO  340
      IF (H1.GT.Z(NL)) GO TO 10                                         GEO  350
      GO TO 20                                                          GEO  360
   10 X=(RE+Z(NL))/(RE+H1)                                              GEO  370
      IF (SPHI.GT.X) GO TO 15                                           GEO  380
      H1=Z(NL)                                                          GEO  390
      J1=NL                                                             GEO  400
      SPHI=SPHI/X                                                       GEO  410
      ANGLE=180.0-ASIN(SPHI)/CA                                         GEO  420
      R1=(RE+H1)*SPHI                                                   GEO  430
      GO TO 20                                                          GEO  440
   15 HMIN=R1-RE                                                        GEO  450
      WRITE (NOUT,235) HMIN                                             GEO  :460
      GO TO 210                                                         GEO  470
   20 CONTINUE                                                          GEO  480
      IP=1                                                              GEO  490
      X1=H1                                                             GEO  500
      CALL POINT (H1,YN,N,NP1,IP)                                       GEO  510
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      J1=N                                                              GEO  520
      TX1=TX(9)                                                         GEO  530
      DO 25 K=1,KMAX                                                    GEO  540
   25 E(K)=TX(K)                                                        GEO  550
      IF (ITYPE.EQ.1) GO TO 80                                          GEO  560
      IF (ITYPE.EQ.3) H2=Z(NL)                                          GEO  570
      IF (ANGLE.GT.90.0) GO TO 90                                       GEO  580
   30 IF (ANGLE.GT.90.0.AND.NP1.GT.0) J1=J1+1                           GEO  590
      J2=NL                                                             GEO  600
      IF (ITYPE.EQ.3) GO TO 35                                          GEO  610
      CALL POINT (H2,YN,N,NP,IP)                                        GEO  620
      J2=N                                                              GEO  630
      IF (NP.GT.0) J2=J2-1                                              GEO  640
   35 DO 40 K=1,KMAX                                                    GEO  650
      IF (K.EQ.9) GO TO 40                                              GEO  660
      EH(K,J1)=E(K)                                                     GEO  670
      IF (ITYPE.EQ.3) GO TO 40                                          GEO  680
      EH(K,J2+1)=TX(K)                                                  GEO  690
   40 CONTINUE                                                          GEO  700
      IF (J1.EQ.J2) TX1=TX1+YN-EH(9,J1)                                 GEO  710
C****  NOW DEFINE VERTICAL PATH QUANTITIES VH                           GEO  720
      IF (JP.EQ.0) WRITE (NOUT,225)                                     GEO :730
      DO 45 K=1,KMAX                                                    GEO  740
   45 W(K)=0.                                                           GEO  750
      DO 75 I=J1,J2                                                     GEO  760
      X1=Z(I)                                                           GEO  770
      IF (I.LT.J2) X2=Z(I+1)                                            GEO :780
      IF (I.EQ.J1) X1=H1                                                GEO  790
      IF (I.EQ.J2) X2=H2                                                GEO  800
      DZ=X2-X1                                                          GEO  810
      IF (I.EQ.NL) DZ=Z(I)-Z(I-1)                                       GEO  820
      DS=DZ                                                             GEO  830
C       UPWARD TRAJECTORY                                               GEO  840
      RX=(RE+X1)/(RE+X2)                                                GEO  850
      THETA=ASIN(SPHI)/CA                                               GEO  860
      PHI=ASIN(SPHI*RX)/CA                                              GEO  870
      BET=THETA-PHI                                                     GEO  880
      SALP=RX*SPHI                                                      GEO  890
      IF (SPHI.GT.1.E-10) DS=(RE+X2)*SIN(BET*CA)/SPHI                   GEO  900
      BETA=BETA+BET                                                     GEO  910
      PSI=BETA+PHI-ANGLE                                                GEO  920
      PHI=180.-PHI                                                      GEO  930
      SR=SR+DS                                                          GEO  940
      JEXTRA=0                                                          GEO  950
      DO 70 K=1,KMAX                                                    GEO  960
      EV=DS*EH(K,I)                                                     GEO  970
      IF (I.EQ.NL) GO TO 50                                             GEO  980
      IF (EH(K,I).EQ.0.0.OR.EH(K,I+1).EQ.0.0) GO TO 55                  GEO  990
      IF (ABS((EH(K,I)/EH(K,I+1))-1.0).LT.1.0E-6) GO TO 60              GEO 1000
      EV=DS*(EH(K,I)-EH(K,I+1))/ALOG(EH(K,I)/EH(K,I+1))                 GEO 1010
      GO TO 60                                                          GEO 1020
   50 IF (EH(K,I).EQ.0.0) GO TO 55                                      GEO 1030
      IF (EH(K,I-1).EQ.0.0) GO TO 55                                    GEO 1040
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```
      IF (ABS((EH(K,I-1)/EH(K,I))-1.0).LT.1.0E-6) GO TO 60          GEO 1050
      EV=EV/ALOG(EH(K,I-1)/EH(K,I))                                 GEO 1060
      GO TO 60                                                      GEO 1070
   55 EV=0.                                                         GEO 1080
   60 VH(K)=VH(K)+EV                                                GEO 1090
      IF (I.EQ.JSTOR) GO TO 65                                      GEO 1100
      WLAY(I,K)=EV+W(K)                                             GEO 1110
      W(K)=0.                                                       GEO 1120
      GO TO 70                                                      GEO 1130
   65 W(K)=EV                                                       GEO 1140
      IF (J1.NE.J2) GO TO 70                                        GEO 1150
      WLAY(J2+1,K)=W(K)                                             GEO 1160
      W(K)=0.                                                       GEO 1170
      JEXTRA=1                                                      GEO 1180
   70 CONTINUE                                                      GEO 1190
      IF (JP.EQ.0) WRITE(NOUT,245) I,X1,(VH(L),L=1,8),PSI,PHI,BETA, GEO:1200
     1      THETA,SR                                                GEO:1201
      IF (JP.EQ.0) WRITE (NOUT,240) X2,(VH(L),L=10,14),DS           GEO:1210
      IF (I.GE.NL) GO TO 75                                         GEO 1220
      IF (I+1.EQ.J2) EH(9,I+1)=YN                                   GEO 1230
      IF (I.EQ.J1) EH(9,I)=TX1                                      GEO 1240
      RN=EH(9,I+1)/EH(9,I)                                          GEO 1250
      SPHI=SPHI*RX/RN                                               GEO 1260
      IF (SALP.GE.RN) SPHI=SALP                                     GEO 1270
   75 CONTINUE                                                      GEO 1280
      GO TO 190                                                     GEO 1290
C     HORIZONTAL PATH                                               GEO 1300
   80 DO 85 K=1,KMAX                                                GEO 1310
      W(K)=RANGE*EH(K,1)                                            GEO 1320
      IF (M.GT.0) W(K)=RANGE*TX(K)                                  GEO 1330
      VH(K)=W(K)                                                    GEO 1340
   85 CONTINUE                                                      GEO 1350
      GO TO 200                                                     GEO 1360
   90 CONTINUE                                                      GEO 1370
C       DOWNWARD TRAJECTORY                                         GEO 1380
      K2=0                                                          GEO 1390
      IF (NP1.EQ.1) J1=J1-1                                         GEO 1400
      J2=J1+1                                                       GEO 1410
      J=J1+1                                                        GEO 1420
      YN1=YN                                                        GEO 1430
      IF (H2.GT.Z(J1+1).OR.H1.EQ.H2) GO TO 100                      GEO 1440
      IF (NP1.EQ.1.AND.H2.GE.Z(J1+1)) GO TO 100                     GEO 1450
      CALL POINT (H2,YN,N,NP2,IP)                                   GEO 1460
      DO 95 K=1,KMAX                                                GEO 1470
   95 W(K)=TX(K)                                                    GEO 1480
      TX2=TX(9)                                                     GEO 1490
      YN2=YN                                                        GEO 1500
      IF (H2.LT.H1) H=H2                                            GEO 1510
      J2=N                                                          GEO 1520
      IF (J1.EQ.J2) TX2=TX1+YN2-EH(9,N)                             GEO 1530
      IF (H2.GT.H1) TX1=TX2                                         GEO 1540
      IF (J1.EQ.J2.AND.H2.LT.H1) YN1=TX2                            GEO 1550
  100 A0=(RE+H1)*SPHI*YN1                                           GEO 1560
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```
      IF (H2.GE.H1) YN2=YN1                                          GEO 1570
      DO 105 I=1,J1                                                  GEO 1580
      HMIN=A0/EH(9,I)-RE                                             GEO 1590
      IF (I.EQ.J1) HMIN=A0/YN1-RE                                    GEO 1600
      JMIN=I                                                         GEO 1610
      IF (HMIN.LE.Z(I+1)) GO TO 110                                  GEO 1620
  105 CONTINUE                                                       GEO 1630
  110 X=HMIN                                                         GEO 1640
      IF (HMIN.LE.0.0) GO TO 120                                     GEO 1650
      CALL POINT (X,YN,N,NP,IP)                                      GEO 1660
      JMIN=N                                                         GEO 1670
      TX3=TX(9)                                                      GEO 1680
      IF (J2.EQ.N.OR.J1.EQ.N) TX3=YN2+TX(9)-EH(9,N)                  GEO 1690
      IF (TX3.LT.0.0) TX3=TX(9)                                      GEO 1700
      IF (J1.EQ.N.AND.H2.GE.H1) GO TO 115                            GEO 1710
      HMIN=A0/TX3-RE                                                 GEO 1720
      IF (ABS(X-HMIN).GT.0.0001) GO TO 110                           GEO 1730
  115 IF (J1.EQ.N.AND.H2.GE.H1) YN1=TX3                              GEO 1740
      IF (J2.EQ.N.AND.J1.NE.J2) YN2=TX3                              GEO 1750
      IF (H2.GE.H1) TX2=TX3                                          GEO 1760
      IF (H2.GE.H1) J2=N                                             GEO 1770
      IF (H2.GE.H1.OR.H2.LT.HMIN) H=HMIN                             GEO 1780
      WRITE (NOUT,250) HMIN                                          GEO:1790
      IF (H2.LT.HMIN) J2=N                                           GEO 1800
      IF (H2.LT.HMIN) WRITE (NOUT,270) HMIN                          GEO:1810
      GO TO 125                                                      GEO 1820
  120 WRITE (NOUT,250) HMIN                                          GEO:1830
      IF (H2.LT.H1) GO TO 125                                        GEO 1840
      IF (ITYPE.EQ.3.OR.H2.GE.H1) WRITE (NOUT,255)                   GEO:1850
      ITYPE=2                                                        GEO 1860
      TX2=EH(9,1)                                                    GEO 1870
      JMIN=0                                                         GEO 1880
      J2=1                                                           GEO 1890
      H2=0.0                                                         GEO 1900
      H=0.0                                                          GEO 1910
C****  NOW DEFINE VERTICAL PATH QUANTITIES VH                        GEO 1920
  125 IF (JP.EQ.0) WRITE (NOUT,225)                                  GEO:1930
      JSTOR=J-1                                                      GEO 1940
      DO 155 I=1,NL                                                  GEO 1950
      J=J-1                                                          GEO 1960
      REF=EH(9,J)                                                    GEO 1970
      IF (I.EQ.1) REF=YN1                                            GEO 1980
      IF (I.EQ.1.AND.K2.EQ.1) REF=YN2                                GEO 1990
      IF (J.EQ.J2.AND.K2.EQ.0) REF=TX2                               GEO 2000
      IF (I.NE.1) X1=Z(J+1)                                          GEO 2010
      X2=Z(J)                                                        GEO 2020
      IF (J.EQ.J2.AND.K2.EQ.0) X2=H                                  GEO 2030
      IF (J.EQ.JMIN.AND.K2.EQ.1) X2=HMIN                             GEO 2040
      HM=(RE+X1)*SPHI-RE                                             GEO 2050
      IF (HM.GT.Z(J).AND.HM.GT.X2) X2=HM                             GEO 2060
      RX=(RE+X1)/(RE+X2)                                             GEO 2070
      DS=X1-X2                                                       GEO 2080
      ALP=90.0                                                       GEO 2090
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      THET=ASIN(SPHI)/CA                                                GEO 2100
      SALP=RX*SPHI                                                      GEO 2110
      IF (ABS(X2-HM).GT.1.0E-5) ALP=ASIN(SALP)/CA                       GEO 2120
      BET=ALP-THET                                                      GEO 2130
      IF (SPHI.GT.1.0E-10) DS=(RE+X2)*SIN(BET*CA)/SPHI                  GEO 2140
      THETA=180.0-THET                                                  GEO 2150
      BETA=BETA+BET                                                     GEO 2160
      PSI=BETA-ALP-ANGLE+180.0                                          GEO 2170
      SR=SR+DS                                                          GEO 2180
      DO 150 K=1,KMAX                                                   GEO 2190
      AJ=EH(K,J)                                                        GEO 2200
      BJ=EH(K,J+1)                                                      GEO 2210
      IF (J.EQ.J1) BJ=E(K)                                              GEO 2220
      IF (J.EQ.J2.AND.H2.LT.H1.AND.H2.GT.0.0) AJ=W(K)                   GEO 2230
      IF (J.EQ.JMIN.AND.H2.GE.H1) AJ=TX(K)                              GEO 2240
      IF (J.EQ.JMIN.AND.ABS(H2-HM).LT.1.0E-5) AJ=TX(K)                  GEO 2250
      IF (K2.EQ.0) GO TO 130                                            GEO 2260
      IF (J.EQ.J2) BJ=W(K)                                              GEO 2270
      IF (J.EQ.JMIN) AJ=TX(K)                                           GEO 2280
  130 IF (AJ.EQ.0.0.OR.BJ.EQ.0.0) GO TO 140                             GEO 2290
      IF (ABS((AJ/BJ)-1.0).LE.1.0E-6) GO TO 135                         GEO 2300
      EV=DS*(AJ-BJ)/ALOG(AJ/BJ)                                         GEO 2310
      GO TO 145                                                         GEO 2320
  135 EV=DS*AJ                                                          GEO 2330
      GO TO 145                                                         GEO 2340
  140 EV=0.0                                                            GEO 2350
  145 VH(K)=VH(K)+EV                                                    GEO 2360
  150 WLAY(J,K)=EV                                                      GEO 2370
      IF (JP.EQ.0) WRITE(NOUT,245) J,X1,(VH(L),L=1,8),PSI,ALP,BETA,     GEO:2380
     1      THETA,SR                                                    GEO:2381
      IF (JP.EQ.0) WRITE (NOUT,240) X2,(VH(L),L=10,14),DS               GEO:2390
      IF (J.EQ.J2.AND.H2.GE.H1) GO TO 180                               GEO 2400
      IF (J.EQ.JMIN.AND.K2.EQ.1) GO TO 170                              GEO 2410
      IF (J.NE.1) RN=REF/EH(9,J-1)                                      GEO 2420
      IF (J.EQ.J2+1) RN=REF/TX2                                         GEO 2430
      IF (J.EQ.J2.AND.K2.EQ.0) RN=REF/YN2                               GEO 2440
      IF (J.EQ.(JMIN+1).AND.K2.EQ.1) RN=REF/TX3                         GEO 2450
      IF (SALP.GE.RN) RN=1.0                                            GEO 2460
      SPHI=SALP*RN                                                      GEO 2470
      IF (J.EQ.J2.AND.K2.EQ.0) GO TO 160                                GEO 2480
  155 CONTINUE                                                          GEO 2490
  160 IF (HMIN.LE.0.0) GO TO 190                                        GEO 2500
      IF (LEN.EQ.0) WRITE (NOUT,260)                                    GEO:2510
      IF (LEN.EQ.0) GO TO 190                                           GEO 2520
      IF (LEN.EQ.1) WRITE (NOUT,265)                                    GEO:2530
      K2=1                                                              GEO 2540
      X1=X2                                                             GEO 2550
      IF (ABS(X1-HMIN).LE.0.001) GO TO 190                              GEO 2560
      H=HMIN                                                            GEO 2570
      J=J2+1                                                            GEO 2580
      IF (NP2.EQ.1) J=J-1                                               GEO 2590
      B=BETA                                                            GEO 2600
      PH=180.0-ASIN(SPHI)/CA                                            GEO 2610
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      TS=SR                                                              GEO 2620
      PS=PSI                                                             GEO 2630
      DO 165 K=1,KMAX                                                    GEO 2640
  165 E(K)=VH(K)                                                         GEO 2650
      GO TO 125                                                          GEO 2660
  170 BETA=2.*BETA-B                                                     GEO 2670
      PSI=2.*PSI-PS                                                      GEO 2680
      SR=2.*SR-TS                                                        GEO 2690
C      LONG PATH  TAKEN                                                  GEO 2700
      PHI=PH                                                             GEO 2710
      DO 175 K=1,KMAX                                                    GEO 2720
  175 VH(K)=2.*VH(K)-E(K)                                                GEO 2730
      GO TO 190                                                          GEO 2740
  180 DO 185 K=1,KMAX                                                    GEO 2750
  185 VH(K)=2.0*VH(K)                                                    GEO 2760
      BETA=2.0*BETA                                                      GEO 2770
      SR=2.0*SR                                                          GEO 2780
      IF (H2.EQ.H1) GO TO 190                                            GEO 2790
      RN=TX1/YN1                                                         GEO 2800
      SPHI=SIN(ANGLE*CA)                                                 GEO 2810
      IF (SPHI.LT.RN) SPHI=SPHI/RN                                       GEO 2820
      GO TO 30                                                           GEO 2830
  190 CONTINUE                                                           GEO 2840
      IF (ANGLE.GT.90.0) WRITE (NOUT,215) HM                             GEO:2850
      DO 195 K=1,KMAX                                                    GEO 2860
      W(K)=VH(K)                                                         GEO 2870
  195 CONTINUE                                                           GEO 2880
  200 WRITE (NOUT,220)                                                   GEO:2890
      WRITE (NOUT,280)                                                   GEO:2900
      WRITE (NOUT,230) (W(I),I=1,8),W(10),W(11)                          GEO:2910
      IF(W(7).GT.0.0.AND.ICH(1).LE.7) W(15)=W(15)/W(7)                   GEO 2920
      IF(W(12).GT.0.0.AND.ICH(1).GT.7) W(15)=W(15)/W(12)                 GEO 2930
  205 WRITE (NOUT,275) (W(I),I=12,15)                                    GEO:2940
      I=1                                                                GEO 2950
  210 RETURN                                                             GEO 2960
C                                                                        GEO 2970
  215 FORMAT (7F10.3)                                                    GEO 2980
  220 FORMAT (/10X,38H EQUIVALENT SEA LEVEL ABSORBER AMOUNTS//21X,112H WGEO 2990
     1ATER VAPOUR     CO2 ETC.       OZONE    NITROGEN (CONT)  H2O  (CONGEO 3000
     2T)     MOL  SCAT      AER1        OZONE(U-V)/24X,7HGM CM-2,10X,2HKGEO 3010
     3M,10X,6HATM CM,10X,2HKM,9X,7HGM CM-2,10X,2HKM,11X,5X,10X,6HATM CM)GEO 3020
  225 FORMAT (1H1,/10X,20H   VERTICAL PROFILES,//,1X,2HID,3X,3HALT,6X,3HGEO 3030
     1H2O,7X,4HCO2+,6X,2HO3,9X,2HN2,6X,8HH2O(10M),4X,4HMOLS,6X,4HAER1,5XGEO 3040
     2,6HO3(UV),5X,3HPSI,6X,3HPHI,6X,4HBETA,4X,5HTHETA,4X,5HRANGE,/,14X,GEO 3050
     35H     ,4X,7HH2O(4M),5X,4HHNO3,6X,4HAER2,6X,4HAER3,6X,4HAER4,3X,5 GEO:3060
     48X,6HDRANGE//)                                                     GEO 3070
  230 FORMAT (/10X,8H W(1-8)=8(E14.3)/74X,E14.3,28X,E14.3/)              GEO 3080
  235 FORMAT (69H TRAJECTORY MISSES EARTHS ATMOSPHERE. CLOSEST DISTANCE GEO 3090
     1OF APPROACH IS,F10.2,1X,/,1X,18HEND OF CALCULATION)                GEO 3100
  240 FORMAT (3X,F8.3,9X,1P5E10.3,55X,0PF7.2,/)                          GEO:3110
  245 FORMAT (I4,F8.3,1P8E10.3,0P4F8.3,F7.1)                             GEO:3120
  250 FORMAT (8H HMIN = ,F10.3)                                          GEO 3130
  255 FORMAT (64H PATH INTERSECTS EARTH - PATH CHANGED TO TYPE 2 WITH H2GEO 3140
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   1 = 0.0 KM)                                                          GEO 3150
260 FORMAT (84H CHOICE OF TWO PATHS FOR THIS CASE -SHORTEST PATH TAKENGEO 3160
   1.  FOR LONGER PATH SET LEN=1.)                                      GEO 3170
265 FORMAT (85H CHOICE OF TWO PATHS FOR THIS CASE -LONGEST PATH TAKEN.GEO 3180
   1   FOR SHORT PATH SET LEN = 0 )                                     GEO 3190
270 FORMAT (74H H2 WAS SET LESS THAN HMIN AND HAS BEEN RESET EQUAL TO GEO 3200
   1    HMIN I.E. H2 = ,F10.3)                                          GEO 3210
275 FORMAT (/30X,4HAER2,10X,4HAER3,10X,4HAER4,5X,9HR.H. MEAN,/10X,10H GEO 3220
   1W(12-15)=,4(1PE14.3)/)                                            GEO 3230
280 FORMAT (118X,11HNITRIC ACID)                                      GEO 3240
    END                                                               GEO 3250
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      SUBROUTINE ANGL (H1,H2,ANGLE,B1,LEN,M,NL,RE,PI,ML)                ANG   10
      DOUBLE PRECISION HZ,SEASN,VULCN                                   ANG  :11
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            ANG   20
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        ANG   30
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          ANG  :31
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        ANG   40
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 ANG  *50
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                              ANG   60
C     ************************************************************************ANG   70
C                                                                       ANG   80
C     THIS SUBROUTINE CALCULATES THE INITIAL ZENITH ANGLE (ANGLE)       ANG   90
C     TAKING INTO ACCOUNT REFRACTION EFFECTS GIVEN H1,H2, AND BETA      ANG  100
C     (WHERE BETA IS THE EARTH CENTRE ANGLE SUBTENDED BY H1 AND H2 ),   ANG  110
C     ASSUMING THE REFRACTIVE INDEX TO BE CONSTANT IN A GIVEN LAYER.    ANG  120
C     FOR GREATER ACCURACY INCREASE THE NUMBER OF LEVELS IN THE MODEL   ANG  130
C     ATMOSPHERE.                                                       ANG  140
C                                                                       ANG  150
C     THIS SUBROUTINE CAN BE REMOVED FROM THE PROGRAM IF NOT REQUIRED.  ANG  160
C     ************************************************************************ANG  170
      IP=99                                                             ANG  180
      CA=PI/180.                                                        ANG  190
      X1=RE+H1                                                          ANG  200
      X2=RE+H2                                                          ANG  210
      LEN=0.                                                            ANG  220
      IT=0                                                              ANG  230
      B1=B1*CA                                                          ANG  240
      TANG=X2*SIN(B1)/(X2*COS(B1)-X1)                                   ANG  250
      THET=ATAN(TANG)                                                   ANG  260
      IF (THET.LT.0.0) THET=THET+PI                                     ANG  270
      SPHI=SIN(THET)                                                    ANG  280
      ANG=THET/CA                                                       ANG  290
      TN=THET                                                           ANG  300
      TM=TN-0.5*CA                                                      ANG  310
    5 ANGLE=THET                                                        ANG  320
      FBT=0.                                                            ANG  330
      BETA=0.                                                           ANG  340
      BET1=0                                                            ANG  350
      BET2=0                                                            ANG  360
      FBT1=0                                                            ANG  370
      FBT2=0                                                            ANG  380
      FBT3=0.0                                                          ANG  390
      IF (B1.LE.0.0) GO TO 10                                           ANG  400
      Y=2.*THET                                                         ANG  410
      IF (Y-PI.GT.1.0E-8) GO TO 45                                      ANG  420
      IF (IP.EQ.100) GO TO 30                                           ANG  430
      XMIN=X2*COS(B1)-RE                                                ANG  440
      IF (XMIN-H1) 40,20,20                                             ANG  450
   10 HMIN=H2                                                           ANG  460
      H2=H1                                                             ANG  470
      H1=HMIN                                                           ANG  480
   15 ANGLE=0.5*PI                                                      ANG  490
      THET=ANGLE                                                        ANG  500
      SPHI=1.0                                                          ANG  510
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      ANG=ANGLE/CA                                                    ANG  520
   20 IP=100                                                          ANG  530
      CALL POINT (H1,YN,N,NP,IP)                                      ANG  540
      J1=N                                                            ANG  550
      TX1=TX(9)                                                       ANG  560
   25 CALL POINT (H2,YN,N,NP,IP)                                      ANG  570
      IF (NP.EQ.1) N=N-1                                              ANG  580
      J2=N                                                            ANG  590
      IF (J1.EQ.J2) TX1=TX1+YN-EH(9,J1)                               ANG  600
   30 DO 35 J=J1,J2                                                   ANG  610
      X1=RE+Z(J)                                                      ANG  620
      X2=RE+Z(J+1)                                                    ANG  630
      IF (J.EQ.J1) X1=RE+H1                                           ANG  640
      IF (J.EQ.J2) X2=RE+H2                                           ANG  650
      SALP=X1*SPHI/X2                                                 ANG  660
      ALP=ASIN(SALP)                                                  ANG  670
      RN=EH(9,J+1)/EH(9,J)                                            ANG  680
      IF ((J+1).EQ.J2) RN=YN/EH(9,J)                                  ANG  690
      IF (J.EQ.J1) RN=EH(9,J+1)/TX1                                   ANG  700
      IF ((J+1).EQ.J2.AND.J.EQ.J1) RN=YN/TX1                          ANG  710
      BET=THET-ALP                                                    ANG  720
      FB=-TAN(ALP)                                                    ANG  730
      IF (J.NE.J1) FB=FB+TAN(THET)                                    ANG  740
      FBT=FBT+FB                                                      ANG  750
      BETA=BETA+BET                                                   ANG  760
      TH1=THET/CA                                                     ANG  770
      BE=BET/CA                                                       ANG  780
      C=ALP/CA                                                        ANG  790
      IF (X2.EQ.RE+H2) C=PI-ALP                                       ANG  800
      IF (SALP.GE.RN) RN=1.                                           ANG  810
      SPHI=SALP/RN                                                    ANG  820
      THET=ASIN(SPHI)                                                 ANG  830
   35 CONTINUE                                                        ANG  840
      IF (B1.LE.0.0) GO TO 125                                        ANG  850
      GO TO 115                                                       ANG  860
   40 CONTINUE                                                        ANG  870
      TANG=-TANG                                                      ANG  880
      ANGLE=PI-ANGLE                                                  ANG  890
      TN=ANGLE                                                        ANG  900
      ANG=ANGLE/CA                                                    ANG  910
      IF (H1.LE.0.0) GO TO 15                                         ANG  920
   45 CONTINUE                                                        ANG  930
      IP=101                                                          ANG  940
      CALL POINT (H1,YN,N,NP1,IP)                                     ANG  950
      TX1=TX(9)                                                       ANG  960
      YN1=YN                                                          ANG  970
      IF (NP1.EQ.1) N=N-1                                             ANG  980
      J2=NL                                                           ANG  990
      IF (M.EQ.7) J2=ML                                               ANG 1000
      J1=N                                                            ANG 1010
      J=J1+1                                                          ANG 1020
      IF (H2.GE.H1) GO TO 65                                          ANG 1030
      CALL POINT (H2,YN,N,NP,IP)                                      ANG 1040
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      TX2=TX(9)                                                          ANG 1050
      YN2=YN                                                             ANG 1060
      J2=N                                                               ANG 1070
      IF (J1.EQ.J2) TX2=YN1+TX(9)-EH(9,J1)                               ANG 1080
   50 J=J-1                                                              ANG 1090
      X1=RE+Z(J+1)                                                       ANG 1100
      X2=RE+Z(J)                                                         ANG 1110
      IF (J.EQ.J1) X1=RE+H1                                              ANG 1120
      IF (J.EQ.J2) X2=RE+H2                                              ANG 1130
      SALP=X1*SPHI/X2                                                    ANG 1140
      HMIN=X1*SPHI-RE                                                    ANG 1150
      IF (SALP.LE.1.0) GO TO 55                                          ANG 1160
      SALP=SPHI                                                          ANG 1170
      IF (HMIN.GT.H2) GO TO 80                                           ANG 1180
   55 ALP=ASIN(SALP)                                                     ANG 1190
      THET=ASIN(SPHI)                                                    ANG 1200
      BET=ALP-THET                                                       ANG 1210
      BET1=BET1+BET                                                      ANG 1220
      FB=TAN(ALP)                                                        ANG 1230
      IF (J.NE.J1) FB=FB-TAN(THET)                                       ANG 1240
      FBT1=FBT1+FB                                                       ANG 1250
      TH1=THET/CA                                                        ANG 1260
      BE=BET/CA                                                          ANG 1270
      AL=ALP/CA                                                          ANG 1280
      IF (X2.EQ.RE+H2) C=PI-ALP                                          ANG 1290
      REF=EH(9,J)                                                        ANG 1300
      IF (J.EQ.J1) REF=YN1                                               ANG 1310
      IF (J.EQ.J2) REF=TX2                                               ANG 1320
      IF (J.EQ.1) GO TO 60                                               ANG 1330
      RN=EH(9,J)/EH(9,J-1)                                               ANG 1340
      IF (J.EQ.J1) RN=YN1/EH(9,J-1)                                      ANG 1350
      IF (J.EQ.J2+1) RN=REF/TX2                                          ANG 1360
      IF (J.EQ.J2) RN=REF/YN2                                            ANG 1370
      IF (SALP.GE.RN) RN=1.                                              ANG 1380
      SPHI=SALP*RN                                                       ANG 1390
      IF (Z(J).LE.H2) GO TO 60                                           ANG 1400
      GO TO 50                                                           ANG 1410
   60 X1=X2                                                              ANG 1420
      IF (ABS(Z(J)-H2).LT.1.0E-10.AND.J.NE.1) GO TO 65                   ANG 1430
      GO TO 70                                                           ANG 1440
   65 J=J-1                                                              ANG 1450
      X1=RE+Z(J+1)                                                       ANG 1460
      IF (J.EQ.J1) X1=RE+H1                                              ANG 1470
      IF (J.EQ.J2.AND.J.NE.J1) X1=RE+H2                                  ANG 1480
   70 X2=RE+Z(J)                                                         ANG 1490
      HMIN=X1*SPHI-RE                                                    ANG 1500
      IF (HMIN.LE.0.0) GO TO 110                                         ANG 1510
      IF (Z(J).LT.HMIN) GO TO 80                                         ANG 1520
      REF=EH(9,J)                                                        ANG 1530
      IF (J.EQ.J2) REF=YN                                                ANG 1540
      SALP=X1*SPHI/X2                                                    ANG 1550
      ALP=ASIN(SALP)                                                     ANG 1560
      THET=ASIN(SPHI)                                                    ANG 1570
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```
      BET=ALP-THET                                                    ANG 1580
      FB=TAN(ALP)-TAN(THET)                                           ANG 1590
      FBT2=FBT2+FB                                                    ANG 1600
      BET2=BET2+BET                                                   ANG 1610
      BMIN=BET1+BET2                                                  ANG 1620
      AL=ALP/CA                                                       ANG 1630
      TH1=THET/CA                                                     ANG 1640
      RN=REF/EH(9,J-1)                                                ANG 1650
      IF (SALP.GE.RN) RN=1.0                                          ANG 1660
      SPHI=SALP*RN                                                    ANG 1670
      GO TO 65                                                        ANG 1680
   75 TX3=YN1+TX(9)-EH(9,J1)                                          ANG 1690
      YN1=TX3                                                         ANG 1700
      IF (ABS(H2-Z(J+1)).LE.1.0E-5) YN1=TX(9)                         ANG 1710
      IF (ABS(H1-Z(J+1)).LE.1.0E-5) YN1=TX(9)                         ANG 1720
      RN=1.0                                                          ANG 1730
      GO TO 85                                                        ANG 1740
   80 CALL POINT (HMIN,YN,N,NP,IP)                                    ANG 1750
      IP=102                                                          ANG 1760
      TX3=TX(9)                                                       ANG 1770
      IF (J.EQ.J1.AND.H2.GE.H1) GO TO 75                              ANG 1780
      IF (J.EQ.J1.OR.J.EQ.J2) TX3=YN2+TX(9)-EH(9,J)                   ANG 1790
      IF (HMIN.GT.H2) TX3=TX(9)                                       ANG 1800
      IF (J.EQ.J1.AND.HMIN.GT.H2) GO TO 75                            ANG 1810
      RN=REF/TX3                                                      ANG 1820
      IF (SALP.GE.RN) RN=1.                                           ANG 1830
      SPHI=SALP*RN                                                    ANG 1840
      X=X1*SPHI-RE                                                    ANG 1850
      DIF=ABS(HMIN-X)                                                 ANG 1860
      HMIN=X                                                          ANG 1870
      IF (DIF-1.0E-5) 85,85,80                                        ANG 1880
   85 X2=RE+HMIN                                                      ANG 1890
      THET=ASIN(SPHI)                                                 ANG 1900
      IF (RN.EQ.1.0) FBT3=-TAN(THET)                                  ANG 1910
      IF (RN.EQ.1.0) GO TO 90                                         ANG 1920
      DNX=(TX3-1.0)*ALOG((TX3-1.0)/(REF-1.0))/(X2-X1)                 ANG 1930
      FBT3=-TAN(THET)*(1.0-1.0/(1.0+TX3/(X2*DNX)))                    ANG 1940
   90 BET=0.5*PI-THET                                                 ANG 1950
      BET2=BET2+BET                                                   ANG 1960
      BMIN=BET1+BET2                                                  ANG 1970
      IF (H2.GE.H1) GO TO 100                                         ANG 1980
      BET=BET1+2.*BET2                                                ANG 1990
      DB1=B1-BET1                                                     ANG 2000
      DB2=BET-B1                                                      ANG 2010
      DB3=ABS(BMIN-B1)                                                ANG 2020
      IF (DB3.GT.DB1.AND.DB2.GT.DB1) GO TO 110                        ANG 2030
      IF (DB2.GT.DB3) GO TO 95                                        ANG 2040
      IF (DB2.GT.DB1) GO TO 110                                       ANG 2050
      BETA=BET                                                        ANG 2060
      FBT=FBT1+2.0*(FBT2+FBT3)                                        ANG 2070
      LEN=1.                                                          ANG 2080
      GO TO 115                                                       ANG 2090
   95 BETA=BET1+BET2                                                  ANG 2100
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      FBT=FBT1+FBT2+FBT3                                              ANG 2110
      GO TO 115                                                       ANG 2120
  100 BETA=2.0*(BET1+BET2)                                            ANG 2130
      LEN=1.                                                          ANG 2140
      FBT=2.0*(FBT1+FBT2+FBT3)                                        ANG 2150
      WRITE (NOUT,130) J,BETA,FBT,FBT1,FBT2,FBT3,TX1,YN1              ANG:2160
      IF (H2.EQ.H1) GO TO 115                                         ANG 2170
      IP=103                                                          ANG 2180
      IF (NP1.EQ.1) J1=J1+1                                           ANG 2190
      SPHI=SIN(ANGLE)                                                 ANG 2200
      IF (Z(J1+1).LE.H2) GO TO 105                                    ANG 2210
      RN=TX1/YN1                                                      ANG 2220
      IF (SPHI.GE.RN) RN=1.                                           ANG 2230
      SPHI=SPHI/RN                                                    ANG 2240
      THET=ASIN(SPHI)                                                 ANG 2250
      GO TO 25                                                        ANG 2260
  105 CALL POINT (H2,YN,N,NP,IP)                                      ANG 2270
      TX1=TX1+YN-EH(9,J1)                                             ANG 2280
      RN=TX1/YN1                                                      ANG 2290
      J2=J1                                                           ANG 2300
      IF (SPHI.GE.RN) RN=1.                                           ANG 2310
      SPHI=SPHI/RN                                                    ANG 2320
      THET=ASIN(SPHI)                                                 ANG 2330
      GO TO 25                                                        ANG 2340
  110 BETA=BET1                                                       ANG 2350
      LEN=0.                                                          ANG 2360
      FBT=FBT1                                                        ANG 2370
  115 THET=ANGLE+(B1-BETA)/(1.+FBT/TANG)                              ANG 2380
      DBETA=BETA/CA                                                   ANG 2390
      B=BET1/CA                                                       ANG 2400
      TH1=THET/CA                                                     ANG 2410
      WRITE (NOUT,135) BETA,DBETA,FBT,TH1,TANG                        ANG:2420
      IF (THET.GT.TN.OR.THET.LT.TM) THET=(TN+TM)/2.                   ANG 2430
      TH1=THET/CA                                                     ANG 2440
      WRITE (NOUT,135) BET1,B,FBT,TH1                                 ANG:2450
      TN1=TN/CA                                                       ANG 2460
      TM1=TM/CA                                                       ANG 2470
      WRITE (NOUT,140) TN,TM,TN1,TM1                                  ANG:2480
      SPHI=SIN(THET)                                                  ANG 2490
      TANG=TAN(THET)                                                  ANG 2500
      IT=IT+1                                                         ANG 2510
      DBE=ABS(B1-BETA)                                                ANG 2520
      DTH=ABS(ANGLE-THET)                                             ANG 2530
      IF (IT.EQ.10) THET=0.5*(ANGLE+THET)                             ANG 2540
      IF (IT.EQ.10) GO TO 120                                         ANG 2550
      IF (DBE.GT.1.0E-7.AND.DTH.GT.1.0E-7) GO TO 5                    ANG 2560
  120 ANGLE=THET/CA                                                   ANG 2570
      WRITE (NOUT,145) ANGLE,IT                                       ANG:2580
      RETURN                                                          ANG 2590
  125 H1=H2                                                           ANG 2600
      ANGLE=C/CA                                                      ANG 2610
      WRITE (NOUT,145) ANGLE,IT                                       ANG:2620
      RETURN                                                          ANG 2630
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C                                                                       ANG 2640
  130 FORMAT (I6,E16.7,8F13.8)                                          ANG 2650
  135 FORMAT (14H TOTAL BETA = ,E14.6,F15.6,7H,FBT = ,E14.6,7H THET =,F1ANG 2660
     10.6,5HTANG=,F10.6)                                                ANG 2670
  140 FORMAT (5F12.6)                                                   ANG 2680
  145 FORMAT (8X,/1H*,14HZENITH ANGLE =,F7.3,59H DEGREES \  RECOMPUTED  ANG:2690
     1    FROM SUBROUTINE ANGL (ITERATION,I3,1H))                      ANG:2700
      END                                                               ANG 2710
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      SUBROUTINE POINT (X,YN,N,NP,IP)                                   POI   10
C                                        REVISED 12 DEC 79              POI   20
      DOUBLE PRECISION HZ,SEASN,VULCN                                   POI  :21
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO  POI   30
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                  POI  *40
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                     POI   50
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI               POI   60
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,JL,JMIN,JEXTRA,IL,IKMAX,NLL,NP1 POI   70
     1,IFIND,NL,IKLO                                                    POI   80
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            POI   90
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        POI  100
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          POI  :101
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        POI  110
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 POI  *120
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                              POI  130
C     ****************************************************************POI  140
C     SUBROUTINE POINT COMPUTES THE MEAN REFR. INDEX ABOVE AND BELOW    POI  150
C     A GIVEN ALTITUDE AND INTERPOLATES EXPONENTIALLY TO DETERMINE THE  POI  160
C     EQUIVALENT ABSORBER AMOUNTS AT THAT ALTITUDE.                     POI  170
C                                                                       POI  180
C     ****************************************************************POI  190
C                                                                       POI  200
C      X IS THE HEIGHT IN QUESTION                                      POI  210
C      TX(9) AND YN ARE THE MEAN REFRACTIVE INDICES ABOVE AND BELOW X   POI  220
C      N IS THE LEVEL INTEGER CORRESPONDING TO X OR THE LEVEL BELOW X   POI  230
C      NP =1 IF X COINCIDES WITH MODEL ATMOSPHERE LEVEL ,IF NOT NP = 0  POI  240
C      TX(1-8) ARE ABSORBER  AMOUNTS PER KM AT HEIGHT X                 POI  250
C     ****************************************************************POI  260
      N=NL                                                              POI  270
      NP=0                                                              POI  280
      IF (X.LT.0.0) X=Z(1)                                              POI  290
      IF (X.GT.Z(NL)) GO TO 20                                          POI  300
      DO 5 I=1,NL                                                       POI  310
      N=I                                                               POI  320
      IF (X-Z(I)) 10,20,5                                               POI  330
    5 CONTINUE                                                          POI  340
   10 J2=N                                                              POI  350
      N=N-1                                                             POI  360
      MM1=M                                                             POI  370
      IF(M1.GT.0.AND.M.LT.7) MM1=M1                                     POI  380
      MM2=M                                                             POI  390
      IF(M2.GT.0.AND.M.LT.7) MM2=M                                      POI  400
      FAC=(X-Z(N))/(Z(J2)-Z(N))                                         POI  410
      PX1=P(MM1,N)*(P(MM1,J2)/P(MM1,N))**FAC                            POI  420
      TX1=T(MM1,N)*(T(MM1,J2)/T(MM1,N))**FAC                            POI  430
      WX1=WH(MM2,N)*(WH(MM2,J2)/WH(MM2,N))**FAC                         POI  440
      TX(3)=CO*PX1/TX1-4.56E-6*WX1*TX1*CW                               POI  450
      TX(2)=CO*P(MM1,J2)/T(MM1,J2)-4.56E-6*WH(MM2,J2)*T(MM1,J2)*CW      POI  460
      TX(1)=CO*P(MM1,N)/T(MM1,N)-4.56E-6*WH(MM2,N)*T(MM1,N)*CW          POI  470
      TX(9)=0.5E-6*(TX(2)+TX(3))                                        POI  480
      YN=0.5E-6*(TX(1)+TX(3))                                           POI  490
      IF (IP.EQ.0) GO TO 35                                             POI  500
      DO 15 K=1,KMAX                                                    POI  510
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      IF (K.EQ.9) GO TO 15                                                  POI  520
      TX(K)=0.0                                                             POI  530
      IF (EH(K,N).GT.1000.0) GO TO 15                                       POI  540
      IF (X.LE.100.0) TX(K)=EH(K,N)÷FAC*(EH(K,J2)-EH(K,N))                 POI  550
      IF (EH(K,N).EQ.0.0.OR.EH(K,J2).EQ.0.0) GO TO 15                       POI  560
      TX(K)=EH(K,N)*(EH(K,J2)/EH(K,N))**FAC                                 POI  570
   15 CONTINUE                                                              POI  580
      GO TO 35                                                              POI  590
   20 NP=1                                                                  POI  600
      IF (IP.EQ.0) GO TO 30                                                 POI  610
      DO 25 K=1,KMAX                                                        POI  620
   25 TX(K)=EH(K,N)                                                         POI  630
   30 TX(9)=EH(9,N)-1.                                                      POI  640
      YN=0.0                                                                POI  650
C       CARDS B 24 AND 50 THROUGH 59 ARE NO LONGER REQUIRED                 POI  660
      IF (N.GT.1) YN=EH(9,N-1)-1.0                                          POI  670
   35 CONTINUE                                                              POI  680
      IF (IP.EQ.1) WRITE (NOUT,45) X,N,NP,TX(9),YN,IP,(TX(K),K=1,8)         POI :690
      IF (IP.EQ.1) WRITE (NOUT,40) (TX(K),K=12,14)                          POI :700
      TX(9)=TX(9)+1.                                                        POI  710
      YN=YN+1.                                                              POI  720
      RETURN                                                                POI  730
C                                                                           POI  740
   40 FORMAT (//5X,11H TX(12-14)=,3E10.3/)                                  POI  750
   45 FORMAT (/,20H FROM POINT\ HEIGHT=,F10.4,6H KM,N=,I3,4H,NP=,I2,28H,POI  760
     1REF. INDEX ABOVE & BELOW X=,2E11.4,4H,IP=,I3,/,12X,36HEQUIV. ABSORPOI  770
     2BER AMOUNTS PER KM AT X=,8E10.3)                                      POI  780
      END                                                                   POI  790
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      SUBROUTINE EXABIN                                                 EXA   10
C                                                                       EXA   20
C      LOADS EXTINCTION AND ABSORPTION COEFFICIENTS FOR THE FOUR        EXA   30
C        AEROSOL ALTITUDE REGIONS                                       EXA   40
C                                                                       EXA   50
      DOUBLE PRECISION HZ,SEASN,VULCN                                   EXA  :51
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO  EXA   60
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                  EXA  *70
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                     EXA   80
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI               EXA   90
      COMMON /CNTRL/ LENST,KMAX,MD,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1EXA  100
     1,IFIND,NL,IKLO                                                    EXA  110
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            EXA  120
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        EXA  130
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          EXA  :131
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        EXA  140
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 EXA  *150
      COMMON ABSC(4,40),EXTC(4,40),VX0(40)                              EXA  160
      COMMON /EXTDTA/  VX2(40),RUREXT(40,4),RURABS(40,4),URBEXT(40,4),  EXA  170
     1URBABS(40,4),OCNEXT(40,4),OCNABS(40,4),TROEXT(40,4),TROABS(40,4), EXA  180
     2FG1EXT(40),FG1ABS(40),FG2EXT(40),FG2ABS(40)                       EXA  190
     3,BSTEXT(40),BSTABS(40),AVOEXT(40),AVOABS(40),FVOEXT(40            EXA  200
     4),FVOABS(40),DMEEXT(40),DMEABS(40)                                EXA  210
      DIMENSION RHZONE(4)                                               EXA  220
      DATA RHZONE /0.,70.,80.,99./                                      EXA  :230
      WRITE (NOUT,90) (ICH(I),I=1,4)                                    EXA  :240
C     CALL EXTDTA                                                       EXA  :250
      DO 5 I=1,40                                                       EXA  260
    5 VX0(I)=VX2(I)                                                     EXA  270
      I1=1                                                              EXA  280
      IF (IHAZE.EQ.7) I1=2                                              EXA  290
      DO 85 M=I1,4                                                      EXA  300
      ITA=ICH(M)                                                        EXA  310
      ITC=ICH(M)-7                                                      EXA  320
      WRH=W(15)                                                         EXA  330
      IF (ICH(M).EQ.6.AND.M.NE.1) WRH=70.                               EXA  340
C     THIS CODING  DOES NOT ALLOW TROP RH DEPENDENT  ABOVE EH(7,I)      EXA  350
C     DEFAULTS TO TROPOSPHERIC AT 70. PERCENT                           EXA  360
      DO 10 I=2,4                                                       EXA  370
      IF (WRH.LT.RHZONE(I)) GO TO 15                                    EXA  380
   10 CONTINUE                                                          EXA  390
      I=4                                                               EXA  400
   15 II=I-1                                                            EXA  410
      IF(WRH.GT.0.0.AND.WRH.LT.99.)X=ALOG(100.0-WRH)                    EXA  420
      X1=ALOG(100.0-RHZONE(II))                                         EXA  430
      X2=ALOG(100.0-RHZONE(I))                                          EXA  440
      IF (WRH.GE.99.0) X=X2                                             EXA  450
      IF (WRH.LE.0.0) X=X1                                              EXA  460
      DO 80 N=1,40                                                      EXA  470
      ABSC(M,N)=0.                                                      EXA  480
      EXTC(M,N)=0.                                                      EXA  490
      IF(ITA.GT.6) GO TO 45                                             EXA  500
      IF(ITA.LE.0) GO TO 80                                             EXA  510
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C     RH DEPENDENT AEROSOLS                                                    EXA  520
      GO TO (20,20,25,25,30,35), ITA                                           EXA  530
   20 Y2=ALOG(RUREXT(N,I))                                                     EXA  540
      Y1=ALOG(RUREXT(N,II))                                                    EXA  550
      Z2=ALOG(RURABS(N,I))                                                     EXA  560
      Z1=ALOG(RURABS(N,II))                                                    EXA  570
      GO TO 40                                                                 EXA  580
   25 Y2=ALOG(OCNEXT(N,I))                                                     EXA  590
      Y1=ALOG(OCNEXT(N,II))                                                    EXA  600
      Z2=ALOG(OCNABS(N,I))                                                     EXA  610
      Z1=ALOG(OCNABS(N,II))                                                    EXA  620
      GO TO 40                                                                 EXA  630
   30 Y2=ALOG(URBEXT(N,I))                                                     EXA  640
      Y1=ALOG(URBEXT(N,II))                                                    EXA  650
      Z2=ALOG(URBABS(N,I))                                                     EXA  660
      Z1=ALOG(URBABS(N,II))                                                    EXA  670
      GO TO 40                                                                 EXA  680
   35 Y2=ALOG(TROEXT(N,I))                                                     EXA  690
      Y1=ALOG(TROEXT(N,II))                                                    EXA  700
      Z2=ALOG(TROABS(N,I))                                                     EXA  710
      Z1=ALOG(TROABS(N,II))                                                    EXA  720
   40 Y=Y1+(Y2-Y1)*(X-X1)/(X2-X1)                                              EXA  730
      ZK=Z1+(Z2-Z1)*(X-X1)/(X2-X1)                                             EXA  740
      ABSC(M,N)=EXP(ZK)                                                        EXA  750
      EXTC(M,N)=EXP(Y)                                                         EXA  760
      GO TO 80                                                                 EXA  770
   45 IF (ITA.GT.14) GO TO 75                                                  EXA  780
      IF (ITC.LT.1) GO TO 80                                                   EXA  790
      GO TO (50,55,60,65,70,65,70), ITC                                        EXA  800
   50 ABSC(M,N)=FG1ABS(N)                                                      EXA  810
      EXTC(M,N)=FG1EXT(N)                                                      EXA  820
      GO TO 80                                                                 EXA  830
   55 ABSC(M,N)=FG2ABS(N)                                                      EXA  840
      EXTC(M,N)=FG2EXT(N)                                                      EXA  850
      GO TO 80                                                                 EXA  860
   60 ABSC(M,N)=BSTABS(N)                                                      EXA  870
      EXTC(M,N)=BSTEXT(N)                                                      EXA  880
      GO TO 80                                                                 EXA  890
   65 ABSC(M,N)=AVOABS(N)                                                      EXA  900
      EXTC(M,N)=AVOEXT(N)                                                      EXA  910
      GO TO 80                                                                 EXA  920
   70 ABSC(M,N)=FVOABS(N)                                                      EXA  930
      EXTC(M,N)=FVOEXT(N)                                                      EXA  940
      GO TO 80                                                                 EXA  950
   75 ABSC(M,N)=DMEABS(N)                                                      EXA  960
      EXTC(M,N)=DMEEXT(N)                                                      EXA  970
   80 CONTINUE                                                                 EXA  980
   85 CONTINUE                                                                 EXA  990
      WRITE (NOUT,95)                                                          EXA:1000
C     WRITE (NOUT,100) (VX2(N),(EXTC(M,N),ABSC(M,N),M=1,4),N=1,40)             EXA:1010
      RETURN                                                                   EXA 1020
C                                                                              EXA 1030
   90 FORMAT (7H  ICH  ,4I5)                                                   EXA 1040
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 95 FORMAT (40H  EXTINCTION AND ABSORPTION COEFFICIENTS)          EXA 1050
100 FORMAT (F10.4,8F10.5)                                        EXA 1060
    END                                                          EXA 1070
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      SUBROUTINE PATH                                                    PAT   10
C     MODIFIED FOR 5CM-1 BAND MODEL OPTION  ---  OCTOBER 1980            PAT  *11
C                                          REVISED 12 DEC 79            PAT   20
C     LOADS CUMULATIVE ABSORBER AMOUNTS INTO THE MATRIX WPATH FROM WLAY  PAT   30
C        FOR THE ATMOSPHERIC SLANT PATH                                  PAT   40
C     USED FOR RADIANCE CALCULATIONS                                     PAT   50
C                                                                        PAT   60
      DOUBLE PRECISION HZ,SEASN,VULCN                                    PAT  :61
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO   PAT   70
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                   PAT  *80
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                      PAT   90
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI                PAT  100
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1  PAT  110
     1,IFIND,NL,IKLO                                                     PAT  120
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)             PAT  130
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                         PAT  140
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                           PAT  :141
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)         PAT  150
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                  PAT *160
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                               PAT  170
      IF (ITYPE.EQ.1) GO TO 60                                           PAT  180
      IF (J1.EQ.J2.AND.J1.EQ.JMIN) GO TO 60                              PAT  190
      IF (ITYPE.EQ.2.AND.H1.EQ.H2) J2=J1                                 PAT  200
      IF (H2.GT.H1.AND.ANGLE.GT.90..AND.NP1.EQ.1) J1=J1-1                PAT  210
      IF (JEXTRA.EQ.1) J2=J2+1                                           PAT  220
      IF ((ITYPE.EQ.2).AND.(H1.GT.H2).AND.(LENST.EQ.1)) J2=J2-1          PAT  230
      IF (ITYPE.EQ.3) J2=NL                                              PAT  240
      IF(JP.EQ.0) WRITE (NOUT,70) J1,J2                                  PAT :250
      IF(JP.EQ.0) WRITE (NOUT,75)                                        PAT :260
      DO 5 IK=1,68                                                       PAT  270
      TBBY(IK)=0.                                                        PAT  280
      PRES(IK) = 0.                                                      PAT *281
      DO 5 K=1,KMAX                                                      PAT  290
      WPATH(IK,K)=0.                                                     PAT  300
    5 CONTINUE                                                           PAT  310
      LEN=0                                                              PAT  320
      NLL=NL-1                                                           PAT  330
      IL=J1+1                                                            PAT  340
      IJ=IL+NLL                                                          PAT  350
      DO 10 K=1,KMAX                                                     PAT  360
      E(K)=0.                                                            PAT  370
   10 CONTINUE                                                           PAT  380
      IF (ANGLE.GT.90.0) GO TO 15                                        PAT  390
      LEN=1.                                                             PAT  400
      IL=J1-1                                                            PAT  410
      HMIN=1.0E-6                                                        PAT  420
      IJ=NLL                                                             PAT  430
   15 CONTINUE                                                           PAT  440
      DO 40 IK=1,68                                                      PAT  450
      IF (LEN.EQ.0) IL=IL-1                                              PAT  460
      IF (LEN.EQ.1) IL=IL+1                                              PAT  470
      IJ=IJ-1                                                            PAT  480
      IF (IL.EQ.0) GO TO 40                                              PAT  490
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      DO 20 K=1,KMAX                                                    PAT  500
C     CHECK FOR THE 5 CM-1 BAND MODEL OPTION.                           PAT *501
C     WHEN USED, WPATH FOR THE FIRST THREE SPECIES                      PAT *502
C     IS THE INCREMENTAL OPTICAL DEPTH FOR EACH LAYER.                  PAT *503
      IF ((JBMOD.EQ.0) .OR. (K.GE.4)) GO TO 18                          PAT *504
      WPATH(IK,K) = WLAY(IL,K)                                          PAT *505
      GO TO 20                                                          PAT *506
   18 CONTINUE                                                          PAT *507
      W(K)=E(K)+WLAY(IL,K)                                              PAT  510
      WPATH(IK,K)=W(K)                                                  PAT  520
   20 CONTINUE                                                          PAT  530
      IF (IL.LE.0.OR.IL.GE.NL) GO TO 25                                 PAT  540
      TBAR=(T(M,IL)+T(M,IL+1))*0.5                                      PAT  550
      IF(M1.GT.0.AND.M.LT.7) TBAR=(T(M1,IL)+T(M1,IL+1))*0.5             PAT  560
      PBAR = 0.5*(P(M,IL)+P(M,IL+1))                                    PAT *561
      IF(M1.GT.0 .AND. M.LT.7) PBAR = 0.5*(P(M1,IL)+P(M1,IL+1))         PAT *562
C                                                                       PAT  570
C     IF (JEXTRA.EQ.1) TBAR=(T(M,J1)+T(M,J1+1))*0.5                     PAT  580
   25 CONTINUE                                                          PAT  590
      TBBY(IK)=TBAR                                                     PAT  600
      PRES(IK) = PBAR                                                   PAT *601
      DO 30 K=1,KMAX                                                    PAT  610
      E(K)=W(K)                                                         PAT  620
   30 CONTINUE                                                          PAT  630
      IF (ANGLE.LE.90.0.AND.IL.EQ.NLL) GO TO 50                         PAT  640
      IF (ITYPE.EQ.3.AND.ANGLE.LE.90.0) GO TO 35                        PAT  650
      IF (ITYPE.EQ.3.AND.LEN.EQ.1.AND.IL.EQ.J2) GO TO 50                PAT  660
      IF (ITYPE.EQ.2.AND.LENST.EQ.0.AND.IL.EQ.J2) GO TO 50              PAT  670
      IF (IL.EQ.JMIN.AND.HMIN.GT.0.0) LEN=1                             PAT  680
      IF (IL.EQ.1.AND.HMIN.LE.0.0) GO TO 50                             PAT  690
      IF (LEN.EQ.0) GO TO 35                                            PAT  700
      IF (IL.EQ.JMIN.AND.IJ.EQ.IL+NLL) IL=IL-1                          PAT  710
      IF (ITYPE.EQ.2.AND.IL.EQ.J2) GO TO 50                             PAT  720
   35 CONTINUE                                                          PAT  730
      IF(JP.EQ.0)WRITE (NOUT,80) IK,(WPATH(IK,K),K=1,8),WPATH(IK,10),   PAT :740
     1WPATH(IK,11),TBBY(IK),PRES(IK)                                    PAT *750
   40 CONTINUE                                                          PAT  760
      IKMAX=68                                                          PAT  770
      LEN=LENST                                                         PAT  780
      IF(JP.NE.0) RETURN                                                PAT  790
      WRITE (NOUT,85)                                                   PAT :800
      DO 45 IK=1,IKMAX                                                  PAT  810
   45 WRITE (NOUT,80) IK,(WPATH(IK,K),K=12,14)                          PAT :820
      RETURN                                                            PAT  830
   50 CONTINUE                                                          PAT  840
      IF(JP.EQ.0) WRITE (NOUT,80) IK,(WPATH(IK,K),K=1,8),WPATH(IK,10)   PAT :850
     1 ,WPATH(IK,11),TBBY(IK),PRES(IK)                                  PAT *860
      IKMAX=IK                                                          PAT  870
      LEN=LENST                                                         PAT  880
      IF(JP.NE.0) RETURN                                                PAT  890
      WRITE (NOUT,85)                                                   PAT :900
      DO 55 IK=1,IKMAX                                                  PAT  910
   55 WRITE (NOUT,80) IK,(WPATH(IK,K),K=12,14)                          PAT :920
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      RETURN                                                              PAT  930
   60 DO 65 K=1,KMAX                                                      PAT  940
      WPATH(1,K)=W(K)                                                     PAT  950
   65 CONTINUE                                                            PAT  960
      IF (M.EQ.0) J1=1                                                    PAT  970
      J2=J1                                                               PAT  980
      TBBY(1)=T(M,J1)                                                     PAT  990
      IF(M1.GT.0.AND.M.LT.7) TBBY(1)=T(M1,J1)                             PAT 1000
      PRES(1) = P(M,J1)                                                   PAT*1001
      IF (M1.GT.0 .AND. M.LT.7) PRES(1) = P(M1,J1)                        PAT*1002
      IKMAX=1                                                             PAT 1010
      IF(JP.EQ.0) WRITE (NOUT,70) J1,J2                                   PAT:1020
      IF(JP.EQ.0) WRITE (NOUT,75)                                         PAT:1030
      IK=1                                                                PAT 1040
      IKMAX=IK                                                            PAT 1050
      IF(JP.EQ.0) WRITE (NOUT,80) IK,(WPATH(IK,K),K=1,8),WPATH(IK,10),    PAT:1060
     1 WPATH(IK,11),TBBY(IK),PRES(IK)                                     PAT:1070
      HMIN=1.0E-6                                                         PAT 1080
      IF(JP.NE.0) RETURN                                                  PAT 1090
      WRITE (NOUT,85)                                                     PAT:1100
      WRITE (NOUT,80) IK,(WPATH(IK,K),K=12,14)                            PAT:1110
      RETURN                                                              PAT 1120
C                                                                         PAT 1130
   70 FORMAT (9I3)                                                        PAT 1140
   75 FORMAT (//,20X,53H CUMULATIVE ABSORBER AMOUNTS FOR THE ATMOSPHERICPAT 1150
     1 PATH,//9X,3HH2O,5X,4HCO2+,7X,2HO3,8X,2HN2,7X,5HH2O C,5X,5HMOL S, PAT*1160
     26X,4HAER1,5X,5HO3 UV,6X,5HH2O C,6X,4HHNO3,5X,4HTAVE,6X,4HPAVE)     PAT*1170
   80 FORMAT (I5,1P10E10.3,0P2F10.3)                                      PAT*1180
   85 FORMAT (//,2X,2HID,4X,4HAER2,7X,4HAER3,7X,4HAER4)                  PAT 1190
      END                                                                 PAT 1200
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      SUBROUTINE TRANS                                                    TRA   10
C     MODIFIED FOR 5CM-1 BAND MODEL OPTION  ---  OCT. 1980               TRA  *11
C                                          REVISED 16 JAN 1980          TRA   20
C     CALCULATES TRANSMITTANCE AND RADIANCE VALUES BETWEEN V1 AND V2      TRA   30
C        FOR A GIVEN ATMOSPHERIC SLANT PATH                               TRA   40
C                                                                         TRA   50
      DOUBLE PRECISION HZ,SEASN,VULCN                                     TRA  :51
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO    TRA   60
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                    TRA  *70
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                       TRA   80
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI                 TRA   90
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1  TRA  100
     1,IFIND,NL,IKLO                                                      TRA  110
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)              TRA  120
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                          TRA  130
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                            TRA  :131
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)          TRA  140
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                   TRA  *150
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                                TRA  160
      COMMON /TRFWFO/ TR(67),FW(67),FO(67)                                TRA  170
      COMMON /C4C5C8/ C4(133),C5(15),C8(102)                              TRA  180
      COMMON /AER/ XX1,XX2,XX3,XX4,YY1,YY2,YY3,YY4                        TRA  190
      DIMENSION ABS(15)                                                   TRA  200
      FF(T,V)=1.190956E-16*(V**5)/(EXP(1.43879*V/T)-1.)                   TRA  210
C       WATTS. CM-2 ST-1 MICRON-1                                         TRA  220
      RADMIN=1.0E+30                                                      TRA  :230
      RADMAX=0.                                                           TRA  240
      VRMIN=0.                                                            TRA  250
      VRMAX=0.                                                            TRA  260
      SUMA=0.                                                             TRA  270
      RADSUM=0.                                                           TRA  280
      FACTOR=0.5                                                          TRA  290
C     CALL C4DTA                                                          TRA  :300
C     CALL TRFN                                                           TRA  310
C                                                                         TRA  *311
C     CALL BMDATA WHEN USING THE 5CM-1 BAND MODEL OPTION                  TRA  *312
      IF (JBMOD.EQ.1) CALL BMDATA                                         TRA  *313
      IV1=V1/5.                                                           TRA  320
      IV2=V2/5.+.99                                                       TRA  330
      IV1=IV1*5                                                           TRA  340
      IV2=IV2*5                                                           TRA  350
      IF (IV1.LT.350) IV1=350                                             TRA  360
      IF (IV2.GT.50000) IV2=50000                                         TRA  370
      IF (DV.LT.5.) DV=5.                                                 TRA  :380
      IDV=DV                                                              TRA  390
      IV=IV1-IDV                                                          TRA  400
C     SET UP FILE NPLT FOR THE PRINT/PLOT OPTION                          TRA  :401
      ENDF = -1.                                                          TRA  :402
      WRITE (NPLT) V1,V2,DV                                               TRA  :407
C                                                                         TRA  :408
      ICOUNT=0                                                            TRA  410
C       BEGINING OF TRANSMITTANCE CALCULATIONS                            TRA  420
    5 IV=IV+IDV                                                           TRA  430
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      SUMV=0.                                                          TRA  440
      TLOLD=1.                                                         TRA  450
      TSOLD=1.                                                         TRA  460
      IKLO=1                                                           TRA  470
      IKHI = IKMAX                                                     TRA *471
      IF (IEMISS.EQ.0) IKHI = IKLO                                     TRA *480
      DO 10 JK=1,11                                                    TRA  490
      ABS(JK)=0.                                                       TRA  500
      IF (JK.LE.3) ABS(JK)=-5.                                         TRA  510
   10 CONTINUE                                                         TRA  520
      IF (JP.NE.0) GO TO 20                                            TRA  530
      IF (ICOUNT.EQ.0) GO TO 15                                        TRA  540
      IF (ICOUNT.EQ.50) GO TO 15                                       TRA  550
      GO TO 20                                                         TRA  560
   15 ICOUNT=0                                                         TRA  570
      IF (IEMISS.EQ.0) WRITE (NOUT,255)                                TRA :580
   20 DO 25 K=1,KMAX                                                   TRA  590
      TX(K)=0.0                                                        TRA  600
      IF (K.LT.4) TX(K)=1.0                                            TRA  610
   25 CONTINUE                                                         TRA  620
      ICOUNT=ICOUNT+1                                                  TRA  630
      SUM=0.0                                                          TRA  640
      V=IV                                                             TRA  650
      I=(IV-350)/5+1                                                   TRA  660
C     ******************  HNO3                                         TRA  670
C     HNO3 ABSORPTION CALCULATION                                      TRA  680
      CALL HNO3 (V,ABS(11))                                            TRA  690
      IF (IV.LT.670) GO TO 80                                          TRA  700
      IF (IV.LE.3000) GO TO 45                                         TRA  710
C     ***   MOLECULAR SCATTERING                                       TRA  720
      ABS(6)=V**4/(9.26799E+18-1.07123E+09*V**2)                       TRA  730
      IF (IV.LT.9200) GO TO 80                                         TRA  740
      IF (IV.LT.13000) GO TO 65                                        TRA  750
C     *** UV OZONE                                                     TRA  760
      IF (IV.LE.23400) GO TO 30                                        TRA  770
      IF (IV.GE.27500) GO TO 35                                        TRA  780
      GO TO 110                                                        TRA  790
   30 XI=(V-13000.0)/200.0+1.                                          TRA  800
      GO TO 40                                                         TRA  810
   35 XI=(V-27500.0)/500.+57.                                          TRA  820
   40 N=XI+1.001                                                       TRA  830
      XD=XI-FLOAT(N)                                                   TRA  840
      ABS(8)=C8(N)+XD*(C8(N)-C8(N-1))                                  TRA  850
      IF (IV.GT.14500) GO TO 110                                       TRA  860
      GO TO 65                                                         TRA  870
C     ***  WATER VAPOR CONTINUUM 10 MICRON REGION                      TRA  880
   45 IF (IV.GT.1350) GO TO 50                                         TRA  890
      ABS(5)=(4.18+5578.0*EXP(-7.87E-3*V))                             TRA  900
      GO TO 55                                                         TRA  910
   50 IF (IV.LT.2350) GO TO 60                                         TRA  920
C     ***  WATER VAPOR CONTINUUM 4 MICRON REGION                       TRA  930
      XI=(V-2350.0)/50.0+1.0                                           TRA  940
      NH=XI+1.001                                                      TRA  950
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      XH=XI-FLOAT(NH)                                                  TRA  960
      ABS(10)=C5(NH)+XH*(C5(NH)-C5(NH-1))                              TRA  970
   55 CONTINUE                                                         TRA  980
      IF (IV.LE.1350.OR.IV.GT.2740) GO TO 80                           TRA  990
C     ***   NITROGEN CONTINUUM                                         TRA 1000
   60 IF (IV.LT.2080) GO TO 80                                         TRA 1010
      K4=I-346                                                         TRA 1020
      ABS(4)=C4(K4)                                                    TRA 1030
      GO TO 80                                                         TRA 1040
C     ***  WATER VAPOUR                                                TRA 1050
   65 IF (IV.LT.12800.AND.IV.GE.9875) GO TO 70                         TRA 1060
      IF (IV.LE.14520.AND.IV.GE.13400) GO TO 75                        TRA 1070
      GO TO 85                                                         TRA 1080
   70 I=I-135                                                          TRA 1090
      GO TO 80                                                         TRA 1100
   75 I=I-255                                                          TRA 1110
   80 IF (JBMOD.NE.1) CALL C1DTA (ABS(1),I)                            TRA*1120
   85 CONTINUE                                                         TRA 1130
C     ***   UNIFORMLY MIXED GASES                                      TRA 1140
C                                                                      TRA*1141
C     SWITCH FOR THE 5CM-1 BAND MODEL                                  TRA*1142
      IF (JBMOD.EQ.1) GO TO 110                                        TRA*1143
      IF (IV.LT.8060.AND.IV.GE.500) GO TO 90                           TRA 1150
      IF (IV.LT.13190.AND.IV.GT.12970) GO TO 95                        TRA 1160
      GO TO 105                                                        TRA 1170
   90 J=I-30                                                           TRA 1180
      GO TO 100                                                        TRA 1190
   95 J=(IV-12950)/5+1516                                              TRA 1200
  100 CALL C2DTA (ABS(2),J)                                            TRA 1210
  105 CONTINUE                                                         TRA 1220
C     ***  OZONE                                                       TRA 1230
      IF (IV.LT.575.OR.IV.GT.3270) GO TO 110                           TRA 1240
      L=I-45                                                           TRA 1250
      CALL C3DTA (ABS(3),L)                                            TRA 1260
  110 CONTINUE                                                         TRA 1270
      CALL AEREXT (V)                                                  TRA 1280
C     INITIAL CALL TO BMOD FOR EACH WAVENUMBER                         TRA*1281
      IK = 0                                                           TRA*1282
      IF (JBMOD.EQ.1) CALL BMOD(IK,V)                                  TRA*1283
C     START OF LAYER LOOP                                              TRA*1284
      DO 210 IK=IKLO,IKHI                                              TRA*1290
      IF (IEMISS.EQ.0) GO TO 120                                       TRA 1300
      DO 115 K=1,KMAX                                                  TRA 1310
      W(K)=WPATH(IK,K)                                                 TRA 1320
  115 CONTINUE                                                         TRA 1330
  120 CONTINUE                                                         TRA 1340
      SUM=0.                                                           TRA 1350
      DO 125 JK=4,11                                                   TRA 1360
      TX(JK)=ABS(JK)*W(JK)                                             TRA 1370
  125 SUM=SUM+TX(JK)                                                   TRA 1380
      TX(5)=TX(5)+TX(10)                                               TRA 1390
C                                                                      TRA*1391
C     SWITCH FOR THE 5CM-1 BAND MODEL OPTION                           TRA*1392
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      IF (JBMOD.EQ.0) GO TO 128                                          TRA*1393
      CALL BMOD(IK,V)                                                    TRA*1394
C     SKIP THE LOWTRAN5 PART FOR H2O, CO2+, AND O3                       TRA*1395
      GO TO 185                                                          TRA*1396
  128 CONTINUE                                                           TRA*1397
      TX(1)=1.0                                                          TRA 1400
      K1=1                                                               TRA 1410
      IF (W(1).LT.1.0E-20) GO TO 145                                     TRA 1420
      IF (ABS(1).LE.-5.0) GO TO 145                                      TRA 1430
      WS1=ALOG10(W(1))+ABS(1)                                            TRA 1440
      IF (WS1.LT.-2.3468) TX(1)=1.-.087787*EXP(1.855595*WS1)             TRA 1450
      IF (WS1.LT.-2.3468) GO TO 145                                      TRA 1460
      IF (WS1.GT.3.5682) GO TO 140                                       TRA 1470
      IF (WS1.GT.2.0) K1=40                                              TRA 1480
      DO 130 K=K1,67                                                     TRA 1490
      IF (WS1.LE.FW(K)) GO TO 135                                        TRA 1500
  130 CONTINUE                                                           TRA 1510
  135 TX(1)=TR(K)+(TR(K-1)-TR(K))*(FW(K)-WS1)/(FW(K)-FW(K-1))            TRA 1520
      GO TO 145                                                          TRA 1530
  140 TX(1)=0.0                                                          TRA 1540
  145 CONTINUE                                                           TRA 1550
      TX(2)=1.0                                                          TRA 1560
      K1=1                                                               TRA 1570
      IF (W(2).LT.1.0E-20) GO TO 165                                     TRA 1580
      IF (ABS(2).LE.-5.0) GO TO 165                                      TRA 1590
      WS2=ALOG10(W(2))+ABS(2)                                            TRA 1600
      IF (WS2.LT.-2.3468) TX(2)=1.-.087787*EXP(1.855595*WS2)             TRA 1610
      IF (WS2.LT.-2.3468) GO TO 165                                      TRA 1620
      IF (WS2.GT.3.5682) GO TO 160                                       TRA 1630
      IF (WS2.GT.2.0) K1=40                                              TRA 1640
      DO 150 K=K1,67                                                     TRA 1650
      IF (WS2.LE.FW(K)) GO TO 155                                        TRA 1660
  150 CONTINUE                                                           TRA 1670
  155 TX(2)=TR(K)+(TR(K-1)-TR(K))*(FW(K)-WS2)/(FW(K)-FW(K-1))            TRA 1680
      GO TO 165                                                          TRA 1690
  160 TX(2)=0.0                                                          TRA 1700
  165 CONTINUE                                                           TRA 1710
      TX(3)=1.                                                           TRA 1720
      K1=1                                                               TRA 1730
      IF (W(3).LT.1.0E-20) GO TO 185                                     TRA 1740
      IF (ABS(3).LE.-5.0) GO TO 185                                      TRA 1750
      WS3=ALOG10(W(3))+ABS(3)                                            TRA 1760
      IF (WS3.LT.-1.6778) TX(3)=1.-.055194*EXP(2.367853*WS3)             TRA 1770
      IF (WS3.LT.-1.6778) GO TO 185                                      TRA 1780
      IF (WS3.GT.3.9345) GO TO 180                                       TRA 1790
      IF (WS3.GT.1.5) K1=36                                              TRA 1800
      DO 170 K=K1,67                                                     TRA 1810
      IF (WS3.LE.FO(K)) GO TO 175                                        TRA 1820
  170 CONTINUE                                                           TRA 1830
  175 TX(3)=TR(K)-(TR(K)-TR(K-1))*(FO(K)-WS3)/(FO(K)-FO(K-1))            TRA 1840
      GO TO 185                                                          TRA 1850
  180 TX(3)=0.0                                                          TRA 1860
  185 CONTINUE                                                           TRA 1870
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      TX(10)=YY1*W(7)+YY2*W(12)+YY3*W(13)+YY4*W(14)                    TRA 1880
      TX(7)=XX1*W(7)+XX2*W(12)+XX3*W(13)+XX4*W(14)                     TRA 1890
      SUM=SUM+TX(7)                                                    TRA 1900
      TX(9)=SUM                                                        TRA 1910
      DO 205 K=4,KMAX                                                  TRA 1920
      IF (TX(K).EQ.0.0) GO TO 195                                      TRA 1930
      IF (TX(K).LE.0.3) GO TO 190                                      TRA 1940
      IF (TX(K).GT.20.) GO TO 200                                      TRA 1950
      TX(K)=EXP(-TX(K))                                                TRA 1960
      GO TO 205                                                        TRA 1970
  190 TX(K)=1.0-TX(K)+0.5*TX(K)*TX(K)                                  TRA 1980
      GO TO 205                                                        TRA 1990
  195 TX(K)=1.0                                                        TRA 2000
      GO TO 205                                                        TRA 2010
  200 TX(K)=0.                                                         TRA 2020
  205 CONTINUE                                                         TRA 2030
      TX(9)=TX(1)*TX(2)*TX(3)*TX(9)                                    TRA 2040
      IF (IV.GE.13000) TX(3)=TX(8)                                     TRA 2050
      ALAM=1.0E+04/V                                                   TRA 2060
      IF (IEMISS.EQ.0) GO TO 220                                       TRA 2070
      BBIK=FF(TBBY(IK),V)                                              TRA 2080
      TLNEW=(TX(9)*TX(10))/(TX(7)*TX(6))                               TRA 2090
      TSNEW=(TX(7)*TX(6))/TX(10)                                       TRA 2100
      DTAU=TLOLD-TLNEW                                                 TRA 2110
      IF (DTAU.LT.1.0E-5.AND.TLNEW.LT.1.0E-5) GO TO 215                TRA 2120
      SUMV=SUMV+0.5*BBIK*DTAU*(TSOLD+TSNEW)                            TRA 2130
      TLOLD=TLNEW                                                      TRA 2140
      TSOLD=TSNEW                                                      TRA 2150
  210 CONTINUE                                                         TRA 2160
  215 CONTINUE                                                         TRA 2170
      TAUG=0                                                           TRA 2180
C ***********  BLACKBODY LOCATED AT ANY H2  *************              TRA:2181
C     IF (HMIN.LE.0.0.AND.IL.EQ.1) TAUG=TX(9)                          TRA:2190
      IF (TBOUND.LE.0.0) GO TO 218                                     TRA:2191
      TAUG = TX(9)                                                     TRA:2192
      T1=TBOUND                                                        TRA 2200
      BBG = 0.0                                                        TRA:2201
      ARG = 1.43879*V/T1                                               TRA:2202
      IF (ARG.LT.50.) BBG=FF(T1,V)*TAUG                                TRA:2210
C     IF (HMIN.LE.0.0) SUMV=SUMV+BBG                                   TRA:2220
      SUMV = SUMV + BBG                                                TRA:2221
  218 SUMVV=SUMV                                                       TRA:2230
      IF (IV.GT.IV1) FACTOR=1.0                                        TRA 2240
      IF (IV.GE.IV2) FACTOR=0.5                                        TRA 2250
      SUMV=(1.0E+04/V**2)*SUMV                                         TRA 2260
      RADSUM=RADSUM+DV*FACTOR*SUMV                                     TRA 2270
      IF (JP.EQ.0) WRITE (NOUT,265) V,ALAM,SUMV,SUMVV,RADSUM,TX(9)     TRA:2280
      IF (SUMV.GE.RADMAX) VRMAX=V                                      TRA 2290
      IF (SUMV.GE.RADMAX) RADMAX=SUMV                                  TRA 2300
      IF (SUMV.LE.RADMIN) VRMIN=V                                      TRA 2310
      IF (SUMV.LE.RADMIN) RADMIN=SUMV                                  TRA 2320
C     WRITE (NSTOR,235) V,ALAM,SUMV,SUMVV,RADSUM,TX(9)                 TRA:2330
      WRITE (NPLT) SUMV,TX(9)                                          TRA:2331
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  220 TX(10)=1.-TX(10)                                                    TRA 2340
      AB=1.-TX(9)                                                         TRA 2350
      IF (IV.EQ.IV1.OR.IV.EQ.IV2) AB=0.5*AB                               TRA 2360
      SUMA=SUMA+AB*DV                                                     TRA 2370
      IF (IEMISS.EQ.1) GO TO 225                                          TRA 2380
      IF (JP.EQ.0) WRITE (NOUT,260) IV,ALAM,TX(9),(TX(K),K=1,7),TX(10),   TRA:2390
     1   SUMA,TX(11)                                                      TRA:2400
C     IF(JP.EQ.0) WRITE (NOUT,483) IV,ALAM,EXTINC,ABSORB                  TRA:2410
C     WRITE (NSTOR,240) IV,ALAM,TX(9),(TX(K),K=1,7),TX(10),TX(11)         TRA:2420
      WRITE (NPLT) SUMV,TX(9)                                             TRA:2421
  225 CONTINUE                                                            TRA 2430
      IF (IV.GE.IV2) GO TO 230                                            TRA 2440
      GO TO 5                                                             TRA 2450
  230 AB=1.0-SUMA/FLOAT(IV-IV1)                                           TRA 2460
      WRITE (NOUT,245) IV1,IV,SUMA,AB                                     TRA:2470
      IF (IEMISS.EQ.1) WRITE (NOUT,250) RADSUM,VRMIN,RADMIN,VRMAX,RADMAXTRA:2480
      WRITE (NPLT) ENDF,ENDF                                              TRA:2481
      RETURN                                                              TRA 2490
C                                                                         TRA 2500
  235 FORMAT (F8.1,F13.6,3E13.5,F13.6)                                    TRA 2510
  240 FORMAT(I6,11F9.4,5X,F9.4)                                           TRA 2520
  245 FORMAT (27H INTEGRATED ABSORPTION FROM,I5,3H TO,I5,7H CM-1 =,F10.2TRA 2530
     1,23HAVERAGE TRANSMITTANCE =,F6.4)                                   TRA 2540
  250 FORMAT (22H INTEGRATED RADIANCE =,E12.5,13HWATT CM -2 SR,/7H RADMITRA 2550
     1N,F12.3,E12.5,/,8H RADMAX ,F12.3,E12.5)                             TRA 2560
  255 FORMAT (1H1,/10X,32H  FREQ WAVELENGTH  TOTAL     H2O,5X,4HCO2+,5X,TRA 2570
     164HOZONE  N2 CONT  H2O CONT MOL SCAT  AEROSOL  AEROSOL   INTEGRATETRA 2580
     2D,12H NITRIC ACID/11X,14H CM-1  MICRONS,8(4X,5HTRANS),4X,20H ABS   TRA 2590
     3   ABSORPTION ,4X,5HTRANS)                                          TRA 2600
  260 FORMAT (10X,I6,10F9.4,F14.4,F9.4)                                   TRA 2610
  265 FORMAT (30X,F8.1,F13.6,3E13.5,F13.6)                                TRA 2620
      END                                                                 TRA 2630
```

```
      SUBROUTINE AEREXT (V)                                              ATR   10
C                                                                        ATR   20
C     INTERPOLATES AEROSOL EXTINCTION AND ABSORPTION COEFFICIENT         ATR   30
C        FOR THE WAVENUMBER, V.                                          ATR   40
C                                                                        ATR   50
      DOUBLE PRECISION HZ,SEASN,VULCN                                    ATR  :51
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO   ATR   60
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                   ATR  *70
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                      ATR   80
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI                ATR   90
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1  ATR  100
     1,IFIND,NL,IKLO                                                     ATR  110
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)             ATR  120
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                         ATR  130
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)         ATR  140
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                  ATR *150
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                               ATR  160
      COMMON /AER/ EXTV(4),ABSV(4)                                       ATR  170
      DO 5 I=1,4                                                         ATR  180
      EXTV(I)=0.                                                         ATR  190
      ABSV(I)=0.                                                         ATR  200
    5 CONTINUE                                                           ATR  210
      IF (IHAZE.EQ.0) RETURN                                             ATR  220
      ALAM=1.0E+4/V                                                      ATR  230
      DO 10 N=1,40                                                       ATR  240
      XD=ALAM-VX2(N)                                                     ATR  250
      IF (XD) 15,10,10                                                   ATR  260
   10 CONTINUE                                                           ATR  270
      N=40                                                               ATR  280
   15 VXD=VX2(N)-VX2(N-1)                                                ATR  290
      DO 20 I=1,4                                                        ATR  300
      EXTV(I)=(EXTC(I,N)-EXTC(I,N-1))*XD/VXD+EXTC(I,N)                   ATR  310
      ABSV(I)=(ABSC(I,N)-ABSC(I,N-1))*XD/VXD+ABSC(I,N)                   ATR  320
   20 CONTINUE                                                           ATR  330
      RETURN                                                             ATR  340
      END                                                                ATR  350
```

```
      SUBROUTINE HNO3 (V,HABS)                                          HNO   10
C                                                                       HNO   20
C     HNO3  STATISTICAL BAND PARAMETERS                                 HNO   30
C                                                                       HNO   40
      DIMENSION H1(15), H2(16), H3(13)                                  HNO   50
C     ARRAY H1 CONTAINS HNO3 ABS, COEF(CM-1ATM-1) FROM  850 TO 920 CM-1 HNO   60
      DATA H1/2.197,3.911,6.154,8.150,9.217,9.461,11.56,11.10,11.17,12.4HNO   70
     10,10.49,7.509,6.136,4.899,2.866/                                  HNO   80
C     ARRAY H2 CONTAINS HNO3 ABS, COEF(CM-1ATM-1) FROM 1275 TO1350 CM-1 HNO   90
      DATA H2/2.828,4.611,6.755,8.759,10.51,13.74,18.00,21.51,23.09,21.6HNO  100
     18,21.32,16.82,16.42,17.87,14.86,8.716/                            HNO  110
C     ARRAY H3 CONTAINS HNO3 ABS, COEF(CM-1ATM-1) FROM 1675 TO1735 CM-1 HNO  120
      DATA H3/5.003,8.803,14.12,19.83,23.31,23.58,23.22,21.09,26.99,25.8HNO  130
     14,24.79,17.68,9.420/                                              HNO  140
      HABS=0.                                                           HNO  150
      IF (V.GE.850.0.AND.V.LE.920.0) GO TO 5                            HNO  160
      IF (V.GE.1275.0.AND.V.LE.1350.0) GO TO 10                         HNO  170
      IF (V.GE.1675.0.AND.V.LE.1735.0) GO TO 15                         HNO  180
      RETURN                                                            HNO  190
    5 I=(V-845.)/5.                                                     HNO  200
      HABS=H1(I)                                                        HNO  210
      RETURN                                                            HNO  220
   10 I=(V-1270.)/5.                                                    HNO  230
      HABS=H2(I)                                                        HNO  240
      RETURN                                                            HNO  250
   15 I=(V-1670.)/5.                                                    HNO  260
      HABS=H3(I)                                                        HNO  270
      RETURN                                                            HNO  280
      END                                                               HNO  290
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      SUBROUTINE BMDATA                                                 BMD  10
C                                                                       BMD  20
C     DEVELOPED OCTOBER 1980                                            BMD  30
C     BMDATA MAKES THE INITIAL TAPE READ AND CALULATES                  BMD  40
C     WAVENUMBER-INDEPENDENT PARAMETERS FOR USE BY BMOD                 BMD  50
C     BMDATA IS CALLED BY TRANS                                         BMD  60
      DOUBLE PRECISION HZ,SEASN,VULCN                                   BMD  70
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO  BMD  80
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                  BMD  90
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                     BMD 100
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI               BMD 110
      COMMON /CARD4/ IXY                                                BMD 120
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1 BMD 130
     1,IFIND,NL,IKLO                                                    BMD 140
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            BMD 150
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        BMD 160
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        BMD 170
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 BMD 180
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                              BMD 190
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          BMD 200
      COMMON /BMDCOM/ SD(5,4,20),OD(5,4,20),ZMWT(4,20),ALFO(4,20),      BMD 210
     1 WT(68),JJ(68),IW,NTEMP,TBAND(5)                                  BMD 220
      DIMENSION UNITS(3)                                                BMD 230
      DATA KSPEC/4/                                                     BMD 240
      DATA UNITS/.0125E5,1.0E5,1.0/                                     BMD 250
C                                                                       BMD 260
C     BAND MODEL PARAMETERS ARE STORED ON A BINARY TAPE (FILE NTBL)     BMD 270
C     IN BLOCKS OF 100CM-1.                                             BMD 280
C     KSPEC  = 1   H2O                                                  BMD 290
C            = 2   UNIFORMLY MIXED GASES                                BMD 300
C            = 3   O3                                                   BMD 310
C            = 4   TAIL CONTRIBUTIONS FROM H2O AND CO2 BANDS            BMD 320
C                                                                       BMD 330
      IKLO = 1                                                          BMD 340
      NTBL = 12                                                         BMD 350
C                                                                       BMD 360
C     READ THE FIRST BLOCK OF BAND MODEL PARAMETERS FROM THE TAPE       BMD 370
C     REWIND TAPE FILE AND READ THE TAPE HEADER                         BMD 380
      REWIND NTBL                                                       BMD 390
      READ (NTBL) VA,VB,NV,NTEMP,(TBAND(N),N=1,NTEMP)                   BMD 400
C                                                                       BMD 410
C     CHECK WAVENUMBER RANGE ON THE TAPE                                BMD 420
C                                                                       BMD 430
      IF (V1.LE.VB .AND. V2.GE.VA) GO TO 10                             BMD 440
      WRITE (NOUT,902) V1,V2,VA,VB                                      BMD 450
      STOP                                                              BMD 460
   10 IF (V1.GE.VA) GO TO 15                                            BMD 470
      WRITE (NOUT,904) V1,VA                                            BMD 480
      V1 = VA                                                           BMD 490
   15 IF (V2.LE.VB) GO TO 20                                            BMD 500
      WRITE (NOUT,906) V2,VB                                            BMD 510
      V2 = VB                                                           BMD 520
C                                                                       BMD 530
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C     ADVANCE THE TAPE TO READ THE FIRST REQUIRED DATA BLOCK                BMD  540
   20 IDV = INT(V1-VA+.00001)                                               BMD  550
      JBLOCK = IDV/100 + 1                                                  BMD  560
      DO 30  J = 1,JBLOCK                                                   BMD  570
      READ (NTBL) (((SD(IT,K,JV),OD(IT,K,JV),IT=1,NTEMP),ALFO(K,JV),        BMD  580
     1       ZMWT(K,JV),K=1,KSPEC),JV=1,20)                                 BMD  590
   30 CONTINUE                                                              BMD  600
C     SET WAVENUMBER COUNTER TO ONE LESS THAN ITS PROPER VALUE FOR V1        BMD  610
      IW = (IDV-100*(JBLOCK-1))/5                                           BMD  620
C                                                                           BMD  630
C     RETURN WHEN ONLY THE SPECTRAL INTERVAL HAS BEEN CHANGED.              BMD  640
      IF (IXY.EQ.1) RETURN                                                  BMD  650
C                                                                           BMD  660
C     WPATH MUST BE SPECIFIED WHEN THE ENTIRE PATH IS WITHIN ONE LAYER      BMD  670
      IF (ITYPE.EQ.1) GO TO 40                                              BMD  680
      IF (J1.EQ.J2 .AND. H1.EQ.H2) GO TO 40                                 BMD  690
      GO TO 50                                                              BMD  700
   40 DO 45  K=1,3                                                          BMD  710
   45 WPATH(1,K) = W(K)                                                     BMD  720
C                                                                           BMD  730
C     CONVERT TO CONSISTENT UNITS FOR OPTICAL PATH--WPATH (CM AMAGATS)      BMD  740
C                                                                           BMD  750
   50 DO 60 K = 1,3                                                         BMD  760
      DO 60 IK = IKLO,IKMAX                                                 BMD  770
   60 WPATH(IK,K) = WPATH(IK,K)*UNITS(K)                                    BMD  780
C                                                                           BMD  790
C     CALCULATE WAVENUMBER-INDEPENDENT QUANTITIES                           BMD  800
      DO 90  IK = IKLO,IKMAX                                                BMD  810
      TT = TBBY(IK)                                                         BMD  820
      WT(IK) = SQRT(TT/273.15)                                              BMD  830
      PRES(IK) = PRES(IK)/1013.                                             BMD  840
C     SET TEMPERATURE INTERPOLATION INDICES FOR EACH LAYER                  BMD  850
      DO 80  J = 1,NTEMP                                                    BMD  860
      IF (TT.GT.TBAND(J)) GO TO 80                                          BMD  870
      JJ(IK) = J                                                            BMD  880
      GO TO 90                                                              BMD  890
   80 CONTINUE                                                              BMD  900
      JJ(IK) = NTEMP + 1                                                    BMD  910
   90 CONTINUE                                                              BMD  920
      RETURN                                                                BMD  930
  902 FORMAT (40H TAPE OUT OF RANGE---REQUESTED (V1,V2) =,                  BMD  940
     1    2F8.0,5X,14HTAPE (VA,VB) =,2F8.0,5X,                             BMD  950
     2    25HPROGRAM STOPPED IN BMDATA)                                     BMD  960
  904 FORMAT (15H LOWER LIMIT OF,F8.0,                                      BMD  970
     1    29H CM-1 IS TOO SMALL---RESET TO,F8.0,5H CM-1)                    BMD  980
  906 FORMAT (15H UPPER LIMIT OF,F8.0,                                      BMD  990
     1    29H CM-1 IS TOO LARGE---RESET TO,F8.0,5H CM-1)                    BMD 1000
      END                                                                   BMD 1010
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      SUBROUTINE BMOD(IK,V)                                              BMO   10
C     WRITTEN SEPT 1980                                                  BMO   20
C     THIS SUBROUTINE CALCULATES THE TRANSMITTANCE AT A SPECTRAL         BMO   30
C     RESOLUTION OF 5 CM-1 FOR THE FOUR "SPECIES"                        BMO   40
C           K = 1      H2O                                               BMO   50
C               2      WELL MIXED GASES---CO2,N2O,CH4,CO,O2              BMO   60
C               3      O3                                                BMO   70
C               4      H2O AND CO2 TAILS                                 BMO   80
C                                                                        BMO   90
      DOUBLE PRECISION HZ,SEASN,VULCN                                    BMO  100
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO   BMO  110
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                   BMO  120
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                      BMO  130
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI                BMO  140
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1  BMO  150
     1,IFIND,NL,IKLO                                                     BMO  160
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)             BMO  170
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                         BMO  180
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)         BMO  190
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                  BMO  200
      COMMON ABSC(4,40),EXTC(4,40),VX2(40)                               BMO  210
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                           BMO  220
      COMMON /BMDCOM/ SD(5,4,20),OD(5,4,20),ZMWT(4,20),ALFO(4,20),       BMO  230
     1 WT(68),JJ(68),IW,NTEMP,TBAND(5)                                   BMO  240
      DIMENSION S1(4),S2(4),S3(4),XS(4),FAC2(4),TRANS(5)                 BMO  250
      DATA KSPEC/4/                                                      BMO  260
C                                                                        BMO  270
C                                                                        BMO  280
C     IK=0 IS THE INITIAL CALL FOR EACH WAVENUMBER AND IS MADE PRIOR     BMO  290
C          TO THE LOOP OVER LAYERS                                       BMO  300
      IF (IK.GT.0) GO TO 40                                              BMO  310
C     IW IS THE COUNTER FOR READING THE DATA TAPES IN BLOCKS OF 20       BMO  320
      IW = IW + 1                                                        BMO  330
      IF (IW.LE.20) GO TO 10                                             BMO  340
C     IF NECESSARY, READ THE NEXT 100 CM-1 BLOCK FROM THE TAPE           BMO  350
      READ (NTBL) (((SD(N,K,JV),OD(N,K,JV),N=1,NTEMP),ALFO(K,JV),        BMO  360
     1     ZMWT(K,JV),K=1,KSPEC),JV=1,20)                                BMO  370
      IW = 1                                                             BMO  380
C     ZERO QUANTITIES FOR THE LAYER LOOP                                 BMO  390
   10 DO 20  K = 1,KSPEC                                                 BMO  400
      S1(K) = 0.0                                                        BMO  410
      S2(K) = 0.0                                                        BMO  420
      S3(K) = 0.0                                                        BMO  430
      XS(K) = 0.0                                                        BMO  440
      FAC2(K) = 0.0                                                      BMO  450
   20 IF (ZMWT(K,IW).GT.0.0) FAC2(K) = V*5.94E-6/SQRT(ZMWT(K,IW))        BMO  460
      RETURN                                                             BMO  470
C                                                                        BMO  480
C                                                                        BMO  490
C                                                                        BMO  500
C *** START CALCULATION OF MOLECULAR TRANSMITTANCE ***                   BMO  510
C                                                                        BMO  520
   40 LMIN = IK                                                          BMO  530
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      LMAX = IK                                                          BMO  540
C     FOR CALCULATING TAU ONLY, LOOP OVER ALL LAYERS  - - LMAX = IKMAX   BMO  550
C     FOR RADIATION CALC'S, LAYER LOOP IS ALREADY IN TRANS - LMAX = IK   BMO  560
      IF (IEMISS.EQ.0) LMAX = IKMAX                                      BMO  570
      TRANS(5) = 1.0                                                     BMO  580
C                                                                        BMO  590
C                                                                        BMO  600
C     START SPECIES LOOP                                                 BMO  610
C     THE 4'TH SPECIES ARE H2O AND CO2 TAIL CONTRIBUTIONS                BMO  620
      DO 90  K = 1,KSPEC                                                 BMO  630
      TRANS(K) = 1.0                                                     BMO  640
C     CHECK FOR MINIMUM ABSORPTION FOR EACH SPECIES AT THIS WAVENUMBER   BMO  650
      IF ((SD(1,K,IW).LT.1.0E-14).AND.(K.NE.4))GO TO 90                  BMO  660
C                                                                        BMO  670
C     START LAYER LOOP                                                   BMO  680
      DO 60  L = LMIN,LMAX                                               BMO  690
      JT = JJ(L)                                                         BMO  700
      TT = TBBY(L)                                                       BMO  710
      CALL CALC(JT,NTEMP,TT,TBAND,SD(1,K,IW),OD(1,K,IW),ABSM,DINV)       BMO  720
      IF (K.NE.4) GO TO 50                                               BMO  730
C     LINE WING CONTINUUM COMPONENTS (K=4) ARE CALCULATED SEPARATELY     BMO  740
C     ABSM IS FOR THE CO2 TAIL---DINV IS FOR THE H2O TAIL                BMO  750
      S1(K) = S1(K) + DINV*WPATH(L,1)*PRES(L)                            BMO  760
      S2(K) = S2(K) + ABSM*WPATH(L,2)*PRES(L)                            BMO  770
      GO TO 60                                                           BMO  780
C     REGULAR MOLECULAR CALCULATION (K=1,2,3)                            BMO  790
   50 CONTINUE                                                           BMO  800
C     (FAC1,XS(K)) = (INCREMENTAL,TOTAL) OPTICAL DEPTH                   BMO  810
      FAC1 = WPATH(L,K)*ABSM                                             BMO  820
      IF(FAC1.LT.1.0E-4) GO TO 60                                        BMO  830
      XS(K) = XS(K) + FAC1                                               BMO  840
      FAC3 = FAC1*DINV                                                   BMO  850
C     MEAN LORENTZ HALF WIDTH                                            BMO  860
      S1(K) = S1(K) + FAC3*PRES(L)/WT(L)                                 BMO  870
C     MEAN DOPLER HALF WIDTH                                             BMO  880
      S2(K) = S2(K) + FAC3*WT(L)                                         BMO  890
C     MEAN LINE DENSITY                                                  BMO  900
      S3(K) = S3(K)+FAC3                                                 BMO  910
   60 CONTINUE                                                           BMO  920
C     CALCULATE EQUIVALENT WIDTH AND TRANSMITTANCE                       BMO  930
      IF((K.EQ.KSPEC).OR.(XS(K).LT.1.0E-3)) GO TO 90                     BMO  940
      ACBAR = ALF0(K,IW)*S1(K)/XS(K)                                     BMO  950
      ADBAR = FAC2(K)*S2(K)/XS(K)                                        BMO  960
      ODBAR = S3(K)/XS(K)                                                BMO  970
      CALL EWIDTH(XS(K),ACBAR,ADBAR,ODBAR,DV,WSL,TRANS(K))               BMO  980
      IF(TRANS(K).LT.1.0) GO TO 90                                       BMO  990
      WSL = WSL/DV                                                       BMO 1000
      ANLINE = ODBAR*DV                                                  BMO 1010
      TRANS(K) = (1.0-WSL)**ANLINE                                       BMO 1020
C     END OF SPECIES LOOP                                                BMO 1030
   90 CONTINUE                                                           BMO 1040
C                                                                        BMO 1050
C     CONTRIBUTION OF H2O AND CO2 TAILS                                  BMO 1060
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      IF (S1(4).GT.50.) S1(4) = 50.                                    BMO 1070
      TRANS(4) = EXP(-S1(4))                                           BMO 1080
      IF (S2(4).GE.50.) S2(4) = 50.                                    BMO 1090
      TRANS(5) = EXP(-S2(4))                                           BMO 1100
C     MULTIPLY IN TAIL CONTRIBUTIONS AND LOAD RESULTANT TRANSMITTANCES BMO 1110
C     INTO THE PROPER LOWTRAN5 ARRAYS                                  BMO 1120
      TX(1) = TRANS(1)*TRANS(4)                                        BMO 1130
      TX(2) = TRANS(2)*TRANS(5)                                        BMO 1140
      TX(3) = TRANS(3)                                                 BMO 1150
      RETURN                                                           BMO 1160
      END                                                              BMO 1170
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      SUBROUTINE CALC(JT,NTEMP,TEMP,TBAND,X1,X2,ABSM,DINV)                CAL  10
C                                                                         CAL  20
C     CALC INTERPOLATES THE BAND MODEL PARAMETERS OVER TEMPERATURE TO     CAL  30
C     OBTAIN S/D AND 1/D FOR A GIVEN TEMPERATURE.                         CAL  40
C     IT IS ASSUMED THAT THE BAND MODEL PARAMETERS ARE TABULATED FOR      CAL  50
C     THE WAVENUMBERS OF THE CALCULATION.                                 CAL  60
C                                                                         CAL  70
C         JT      =  INDEX FOR THE FIRST TBAND LARGER THAN TEMP           CAL  80
C         NTEMP   =  NUMBER OF TEMPERATURE POINTS FOR X1 AND X2           CAL  90
C         TBAND   =  TEMPERATURES FOR TABULATED BAND MODEL PARAMETERS     CAL 100
C         TEMP    =  TEMPERATURE FOR WHICH ABSM & DINV ARE NEEDED         CAL 110
C         X1      =  S/D (ABSORPTION COEFFICIENT) FROM BMOD               CAL 120
C         X2      =  1/D (LINE SPACING) OR S/D FOR MIXED GASES' TAILS     CAL 130
C         ABSM    =  RETURNED VALUE OF S/D FOR INPUT TEMP                 CAL 140
C         DINV    =  RETURNED VALUE OF 1/D FOR INPUT TEMP                 CAL 150
C                                                                         CAL 160
      DIMENSION X1(1),X2(1),TBAND(1)                                      CAL 170
C                                                                         CAL 180
C***  LINEAR INTERPOLATING FUNCTION                                       CAL 190
      F1(Y1,Y2,T1,T2,T3) = Y1 + (Y2-Y1)*(T3-T1)/(T2-T1)                   CAL 200
C                                                                         CAL 210
C                                                                         CAL 220
      IF (JT.GT.NTEMP) GO TO 30                                           CAL 230
      IF (JT.GT.1) GO TO 20                                               CAL 240
      ABSM = X1(1)                                                        CAL 250
      DINV = X2(1)                                                        CAL 260
      RETURN                                                              CAL 270
20    JT1 = JT - 1                                                        CAL 280
      ABSM = F1(X1(JT1),X1(JT),TBAND(JT1),TBAND(JT),TEMP)                 CAL 290
      DINV = F1(X2(JT1),X2(JT),TBAND(JT1),TBAND(JT),TEMP)                 CAL 300
      RETURN                                                              CAL 310
30    ABSM = X1(NTEMP)                                                    CAL 320
      DINV = X2(NTEMP)                                                    CAL 330
      RETURN                                                              CAL 340
      END                                                                 CAL 350
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      BLOCK DATA                                                        BLK   10
      DOUBLE PRECISION HZ,SEASN,VULCN                                   BLK   20
      COMMON /CARD1/ MODEL,IHAZE,ITYPE,LEN,JP,IM,M1,M2,M3,ML,IEMISS,RO  BLK   30
     1 ,TBOUND,ISEASN,IVULCN,VIS,JBMOD                                  BLK   40
      COMMON /CARD2/ H1,H2,ANGLE,RANGE,BETA,HMIN,RE                     BLK   50
      COMMON /CARD3/ V1,V2,DV,AVW,CO,CW,W(15),E(15),CA,PI               BLK   60
      COMMON /CNTRL/ LENST,KMAX,M,IJ,J1,J2,JMIN,JEXTRA,IL,IKMAX,NLL,NP1 BLK   70
     1,IFIND,NL,IKLO                                                    BLK   80
      COMMON /MDATA/ Z(34),P(7,34),T(7,34),WH(7,34),WO(7,34)            BLK   90
     1 ,SEASN(2),VULCN(5),VSB(9),HZ(15),HMIX(34)                        BLK  100
      COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)        BLK  110
      COMMON WLAY(34,15),WPATH(68,15),TBBY(68),PRES(68)                 BLK  120
      COMMON ABSC(4,40),EXTC(4,40),VX22(40)                             BLK  130
      COMMON/PRFDTA/ZHT(34),HZ2K(34,5),FAWI50(34),FAWI23(34),SPSU50(34),BLK  140
     1SPSU23(34),BASTFW(34),VUMOFW(34),HIVUFW(34),EXVUFW(34),BASTSS(34),BLK  150
     2VUMOSS(34),HIVUSS(34),EXVUSS(34),UPNATM(34),VUTONO(34),           BLK  160
     3VUTOEX(34),EXUPAT(34)                                             BLK  170
      COMMON /EXTDTA/VX2(40),RUREXT(40,4),RURABS(40,4),URBEXT(40,4),    BLK  180
     1URBABS(40,4),OCNEXT(40,4),OCNABS(40,4),TROEXT(40,4),TROABS(40,4), BLK  190
     2FG1EXT(40),FG1ABS(40),FG2EXT(40),FG2ABS(40),                      BLK  200
     3  BSTEXT(40),BSTABS(40),AVOEXT(40),AVOABS(40),FVOEXT(40),         BLK  210
     4  FVOABS(40),DMEEXT(40),DMEABS(40)                                BLK  220
      COMMON /TRFWFO/ TR(67),FW(67),FO(67)                              BLK  230
      COMMON /C4C5C8/ C4(133),C5(15),C8(102)                            BLK  240
C                                                                       BLK  250
      DIMENSION PO(238),P1(114),P2(114),P3(10)                          BLK  260
      EQUIVALENCE (P,PO,P1),(P2,PO(115)),(P3,PO(229))                   BLK  270
      DIMENSION TO(238),T1(114),T2(114),T3(10)                          BLK  280
      EQUIVALENCE (T,TO,T1),(T2,TO(115)),(T3,TO(229))                   BLK  290
      DIMENSION WHO(238),WH1(114),WH2(114),WH3(10)                      BLK  300
      EQUIVALENCE (WH,WHO,WH1),(WH2,WHO(115)),(WH3,WHO(229))            BLK  310
      DIMENSION WOO(238),WO1(114),WO2(114),WO3(10)                      BLK  320
      EQUIVALENCE (WO,WOO,WO1),(WO2,WOO(115)),(WO3,WOO(229))            BLK  330
      DIMENSION RURXT1(80),RURXT2(80)                                   BLK  340
      EQUIVALENCE (RUREXT,RURXT1),(RUREXT(1,3),RURXT2)                  BLK  350
      DIMENSION RURBS1(80),RURBS2(80)                                   BLK  360
      EQUIVALENCE (RURABS,RURBS1),(RURABS(1,3),RURBS2)                  BLK  370
      DIMENSION URBXT1(80),URBXT2(80)                                   BLK  380
      EQUIVALENCE (URBEXT,URBXT1),(URBEXT(1,3),URBXT2)                  BLK  390
      DIMENSION URBBS1(80),URBBS2(80)                                   BLK  400
      EQUIVALENCE (URBABS,URBBS1),(URBABS(1,3),URBBS2)                  BLK  410
      DIMENSION OCNXT1(80),OCNXT2(80)                                   BLK  420
      EQUIVALENCE (OCNEXT,OCNXT1),(OCNEXT(1,3),OCNXT2)                  BLK  430
      DIMENSION OCNBS1(80),OCNBS2(80)                                   BLK  440
      EQUIVALENCE (OCNABS,OCNBS1),(OCNABS(1,3),OCNBS2)                  BLK  450
      DIMENSION TROXT1(80),TROXT2(80)                                   BLK  460
      EQUIVALENCE (TROEXT,TROXT1),(TROEXT(1,3),TROXT2)                  BLK  470
      DIMENSION TROBS1(80),TROBS2(80)                                   BLK  480
      EQUIVALENCE (TROABS,TROBS1),(TROABS(1,3),TROBS2)                  BLK  490
      DIMENSION C4A(114),C4B(19)                                        BLK  500
      EQUIVALENCE (C4,C4A),(C4(115),C4B)                                BLK  510
C     SUBROUTINE MDTA                                                   BLK  520
C                                                                       BLK  530
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C     MODEL ATMOSPHERE DATA                                                  BLK  540
C                                                                            BLK  550
C     DATA LATM/6/                                                           BLK  560
      DATA NL/  34/                                                          BLK  570
      DATA  Z              /                                                 BLK  580
     1    0.,    1.,    2.,    3.,    4.,    5.,    6.,    7.,    8.,       BLK  590
     2    9.,   10.,   11.,   12.,   13.,   14.,   15.,   16.,   17.,       BLK  600
     3   18.,   19.,   20.,   21.,   22.,   23.,   24.,   25.,   30.,       BLK  610
     4   35.,   40.,   45.,   50.,   70.,  100.,99999./                     BLK  620
      DATA  P1/                                                              BLK  630
     * 1.013E+03, 1.013E+03, 1.018E+03, 1.010E+03, 1.013E+03, 1.013E+03,BLK  640
     * 0.000E-01, 9.040E+02, 9.020E+02, 8.973E+02, 8.960E+02, 8.878E+02,BLK  650
     * 8.986E+02, 0.000E-01, 8.050E+02, 8.020E+02, 7.897E+02, 7.929E+02,BLK  660
     * 7.775E+02, 7.950E+02, 0.000E-01, 7.150E+02, 7.100E+02, 6.938E+02,BLK  670
     * 7.000E+02, 6.798E+02, 7.012E+02, 0.000E-01, 6.330E+02, 6.280E+02,BLK  680
     * 6.081E+02, 6.160E+02, 5.932E+02, 6.166E+02, 0.000E-01, 5.590E+02,BLK  690
     * 5.540E+02, 5.313E+02, 5.410E+02, 5.158E+02, 5.405E+02, 0.000E-01,BLK  700
     * 4.920E+02, 4.870E+02, 4.627E+02, 4.730E+02, 4.467E+02, 4.722E+02,BLK  710
     * 0.000E-01, 4.320E+02, 4.260E+02, 4.016E+02, 4.130E+02, 3.853E+02,BLK  720
     * 4.111E+02, 0.000E-01, 3.780E+02, 3.720E+02, 3.473E+02, 3.590E+02,BLK  730
     * 3.308E+02, 3.565E+02, 0.000E-01, 3.290E+02, 3.240E+02, 2.992E+02,BLK  740
     * 3.107E+02, 2.829E+02, 3.080E+02, 0.000E-01, 2.860E+02, 2.810E+02,BLK  750
     * 2.568E+02, 2.677E+02, 2.418E+02, 2.650E+02, 0.000E-01, 2.470E+02,BLK  760
     * 2.430E+02, 2.199E+02, 2.300E+02, 2.067E+02, 2.270E+02, 0.000E-01,BLK  770
     * 2.130E+02, 2.090E+02, 1.882E+02, 1.977E+02, 1.766E+02, 1.940E+02,BLK  780
     * 0.000E-01, 1.820E+02, 1.790E+02, 1.610E+02, 1.700E+02, 1.510E+02,BLK  790
     * 1.658E+02, 0.000E-01, 1.560E+02, 1.530E+02, 1.378E+02, 1.460E+02,BLK  800
     * 1.291E+02, 1.417E+02, 0.000E-01, 1.320E+02, 1.300E+02, 1.178E+02,BLK  810
     * 1.250E+02, 1.103E+02, 1.211E+02, 0.000E-01, 1.110E+02, 1.110E+02/BLK  820
      DATA  P2/                                                              BLK  830
     * 1.007E+02, 1.080E+02, 9.431E+01, 1.035E+02, 0.000E-01, 9.370E+01,BLK  840
     * 9.500E+01, 8.610E+01, 9.280E+01, 8.058E+01, 8.850E+01, 0.000E-01,BLK  850
     * 7.890E+01, 8.120E+01, 7.350E+01, 7.980E+01, 6.882E+01, 7.565E+01,BLK  860
     * 0.000E-01, 6.660E+01, 6.950E+01, 6.280E+01, 6.860E+01, 5.875E+01,BLK  870
     * 6.467E+01, 0.000E-01, 5.650E+01, 5.950E+01, 5.370E+01, 5.890E+01,BLK  880
     * 5.014E+01, 5.529E+01, 0.000E-01, 4.800E+01, 5.100E+01, 4.580E+01,BLK  890
     * 5.070E+01, 4.277E+01, 4.729E+01, 0.000E-01, 4.090E+01, 4.370E+01,BLK  900
     * 3.910E+01, 4.360E+01, 3.647E+01, 4.047E+01, 0.000E-01, 3.500E+01,BLK  910
     * 3.760E+01, 3.340E+01, 3.750E+01, 3.109E+01, 3.467E+01, 0.000E-01,BLK  920
     * 3.000E+01, 3.220E+01, 2.860E+01, 3.227E+01, 2.649E+01, 2.972E+01,BLK  930
     * 0.000E-01, 2.570E+01, 2.770E+01, 2.430E+01, 2.780E+01, 2.256E+01,BLK  940
     * 2.549E+01, 0.000E-01, 1.220E+01, 1.320E+01, 1.110E+01, 1.340E+01,BLK  950
     * 1.020E+01, 1.197E+01, 0.000E-01, 6.000E+00, 6.520E+00, 5.180E+00,BLK  960
     * 6.610E+00, 4.701E+00, 5.746E+00, 0.000E-01, 3.050E+00, 3.330E+00,BLK  970
     * 2.530E+00, 3.400E+00, 2.243E+00, 2.871E+00, 0.000E-01, 1.590E+00,BLK  980
     * 1.760E+00, 1.290E+00, 1.810E+00, 1.113E+00, 1.491E+00, 0.000E-01,BLK  990
     * 8.540E-01, 9.510E-01, 6.820E-01, 9.870E-01, 5.719E-01, 7.978E-01,BLK 1000
     * 0.000E-01, 5.790E-02, 6.710E-02, 4.670E-02, 7.070E-02, 4.016E-02,BLK 1010
     * 5.520E-02, 0.000E-01, 3.000E-04, 3.000E-04, 3.000E-04, 3.000E-04/BLK 1020
      DATA  P3/                                                              BLK 1030
     * 3.000E-04, 3.008E-04, 0.000E-01, 0.000E-01, 0.000E-01, 0.000E-01,BLK 1040
     * 0.000E-01, 0.000E-01, 0.000E-01, 0.000E-01/                           BLK 1050
      DATA T1 /                                                              BLK 1060
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* 3.000E+02, 2.940E+02, 2.722E+02, 2.870E+02, 2.571E+02, 2.881E+02,BLK 1070
* 0.000E-01, 2.940E+02, 2.900E+02, 2.687E+02, 2.820E+02, 2.591E+02,BLK 1080
* 2.816E+02, 0.000E-01, 2.880E+02, 2.850E+02, 2.652E+02, 2.760E+02,BLK 1090
* 2.559E+02, 2.751E+02, 0.000E-01, 2.840E+02, 2.790E+02, 2.617E+02,BLK 1100
* 2.710E+02, 2.527E+02, 2.687E+02, 0.000E-01, 2.770E+02, 2.730E+02,BLK 1110
* 2.557E+02, 2.660E+02, 2.477E+02, 2.622E+02, 0.000E-01, 2.700E+02,BLK 1120
* 2.670E+02, 2.497E+02, 2.600E+02, 2.409E+02, 2.557E+02, 0.000E-01,BLK 1130
* 2.640E+02, 2.610E+02, 2.437E+02, 2.530E+02, 2.341E+02, 2.492E+02,BLK 1140
* 0.000E-01, 2.570E+02, 2.550E+02, 2.377E+02, 2.460E+02, 2.273E+02,BLK 1150
* 2.427E+02, 0.000E-01, 2.500E+02, 2.480E+02, 2.317E+02, 2.390E+02,BLK 1160
* 2.206E+02, 2.362E+02, 0.000E-01, 2.440E+02, 2.420E+02, 2.257E+02,BLK 1170
* 2.320E+02, 2.172E+02, 2.297E+02, 0.000E-01, 2.370E+02, 2.350E+02,BLK 1180
* 2.197E+02, 2.250E+02, 2.172E+02, 2.232E+02, 0.000E-01, 2.300E+02,BLK 1190
* 2.290E+02, 2.192E+02, 2.250E+02, 2.172E+02, 2.168E+02, 0.000E-01,BLK 1200
* 2.240E+02, 2.220E+02, 2.187E+02, 2.250E+02, 2.172E+02, 2.166E+02,BLK 1210
* 0.000E-01, 2.170E+02, 2.160E+02, 2.182E+02, 2.250E+02, 2.172E+02,BLK 1220
* 2.166E+02, 0.000E-01, 2.100E+02, 2.160E+02, 2.177E+02, 2.250E+02,BLK 1230
* 2.172E+02, 2.166E+02, 0.000E-01, 2.040E+02, 2.160E+02, 2.172E+02,BLK 1240
* 2.250E+02, 2.172E+02, 2.166E+02, 0.000E-01, 1.970E+02, 2.160E+02/BLK 1250
 DATA T2 /                                                        BLK 1260
* 2.167E+02, 2.250E+02, 2.166E+02, 2.166E+02, 0.000E-01, 1.950E+02,BLK 1270
* 2.160E+02, 2.162E+02, 2.250E+02, 2.160E+02, 2.166E+02, 0.000E-01,BLK 1280
* 1.990E+02, 2.160E+02, 2.157E+02, 2.250E+02, 2.154E+02, 2.166E+02,BLK 1290
* 0.000E-01, 2.030E+02, 2.170E+02, 2.152E+02, 2.250E+02, 2.148E+02,BLK 1300
* 2.166E+02, 0.000E-01, 2.070E+02, 2.180E+02, 2.152E+02, 2.250E+02,BLK 1310
* 2.141E+02, 2.166E+02, 0.000E-01, 2.110E+02, 2.190E+02, 2.152E+02,BLK 1320
* 2.250E+02, 2.136E+02, 2.176E+02, 0.000E-01, 2.150E+02, 2.200E+02,BLK 1330
* 2.152E+02, 2.250E+02, 2.130E+02, 2.186E+02, 0.000E-01, 2.170E+02,BLK 1340
* 2.220E+02, 2.152E+02, 2.250E+02, 2.124E+02, 2.196E+02, 0.000E-01,BLK 1350
* 2.190E+02, 2.230E+02, 2.152E+02, 2.260E+02, 2.118E+02, 2.206E+02,BLK 1360
* 0.000E-01, 2.210E+02, 2.240E+02, 2.152E+02, 2.280E+02, 2.112E+02,BLK 1370
* 2.216E+02, 0.000E-01, 2.320E+02, 2.340E+02, 2.174E+02, 2.350E+02,BLK 1380
* 2.160E+02, 2.265E+02, 0.000E-01, 2.430E+02, 2.450E+02, 2.278E+02,BLK 1390
* 2.470E+02, 2.222E+02, 2.365E+02, 0.000E-01, 2.540E+02, 2.580E+02,BLK 1400
* 2.432E+02, 2.620E+02, 2.347E+02, 2.534E+02, 0.000E-01, 2.650E+02,BLK 1410
* 2.700E+02, 2.585E+02, 2.740E+02, 2.470E+02, 2.642E+02, 0.000E-01,BLK 1420
* 2.700E+02, 2.760E+02, 2.657E+02, 2.770E+02, 2.593E+02, 2.706E+02,BLK 1430
* 0.000E-01, 2.190E+02, 2.180E+02, 2.307E+02, 2.160E+02, 2.457E+02,BLK 1440
* 2.197E+02, 0.000E-01, 2.100E+02, 2.100E+02, 2.102E+02, 2.100E+02/BLK 1450
 DATA T3 /                                                        BLK 1460
* 2.100E+02, 2.100E+02, 0.000E-01, 2.100E+02, 2.100E+02, 2.100E+02,BLK 1470
* 2.100E+02, 2.100E+02, 2.100E+02, 0.000E-01/                     BLK 1480
 DATA WH1 /                                                       BLK 1490
* 1.900E+01, 1.400E+01, 3.500E+00, 9.100E+00, 1.200E+00, 5.900E+00,BLK 1500
* 0.000E-01, 1.300E+01, 9.300E+00, 2.500E+00, 6.000E+00, 1.200E+00,BLK 1510
* 4.200E+00, 0.000E-01, 9.300E+00, 5.900E+00, 1.800E+00, 4.200E+00,BLK 1520
* 9.400E-01, 2.900E+00, 0.000E-01, 4.700E+00, 3.300E+00, 1.200E+00,BLK 1530
* 2.700E+00, 6.800E-01, 1.800E+00, 0.000E-01, 2.200E+00, 1.900E+00,BLK 1540
* 6.600E-01, 1.700E+00, 4.100E-01, 1.100E+00, 0.000E-01, 1.500E+00,BLK 1550
* 1.000E+00, 3.800E-01, 1.000E+00, 2.000E-01, 6.400E-01, 0.000E-01,BLK 1560
* 8.500E-01, 6.100E-01, 2.100E-01, 5.400E-01, 9.800E-02, 3.800E-01,BLK 1570
* 0.000E-01, 4.700E-01, 3.700E-01, 8.500E-02, 2.900E-01, 5.400E-02,BLK 1580
* 2.100E-01, 0.000E-01, 2.500E-01, 2.100E-01, 3.500E-02, 1.300E-01,BLK 1590
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* 1.100E-02, 1.200E-01, 0.000E-01, 1.200E-01, 1.200E-01, 1.600E-02,BLK 1600
* 4.200E-02, 8.400E-02, 4.600E-02, 0.000E-01, 5.000E-02, 6.400E-02,BLK 1610
* 7.500E-03, 1.500E-02, 5.500E-03, 1.800E-02, 0.000E-01, 1.700E-02,BLK 1620
* 2.200E-02, 6.900E-03, 9.400E-03, 3.800E-03, 8.200E-03, 0.000E-01,BLK 1630
* 6.000E-03, 6.000E-03, 6.000E-03, 6.000E-03, 2.600E-03, 3.700E-03,BLK 1640
* 0.000E-01, 1.800E-03, 1.800E-03, 1.800E-03, 1.800E-03, 1.800E-03,BLK 1650
* 1.800E-03, 0.000E-01, 1.000E-03, 1.000E-03, 1.000E-03, 1.000E-03,BLK 1660
* 1.000E-03, 8.400E-04, 0.000E-01, 7.600E-04, 7.600E-04, 7.600E-04,BLK 1670
* 7.600E-04, 7.600E-04, 7.200E-04, 0.000E-01, 6.400E-04, 6.400E-04/BLK 1680
 DATA WH2 /                                                        BLK 1690
* 6.400E-04, 6.400E-04, 6.400E-04, 6.100E-04, 0.000E-01, 5.600E-04,BLK 1700
* 5.600E-04, 5.600E-04, 5.600E-04, 5.600E-04, 5.200E-04, 0.000E-01,BLK 1710
* 5.000E-04, 5.000E-04, 5.000E-04, 5.000E-04, 5.000E-04, 4.400E-04,BLK 1720
* 0.000E-01, 4.900E-04, 4.900E-04, 4.900E-04, 4.900E-04, 4.900E-04,BLK 1730
* 4.400E-04, 0.000E-01, 4.500E-04, 4.500E-04, 4.500E-04, 4.500E-04,BLK 1740
* 4.500E-04, 4.400E-04, 0.000E-01, 5.100E-04, 5.100E-04, 5.100E-04,BLK 1750
* 5.100E-04, 5.100E-04, 4.800E-04, 0.000E-01, 5.100E-04, 5.100E-04,BLK 1760
* 5.100E-04, 5.100E-04, 5.100E-04, 5.200E-04, 0.000E-01, 5.400E-04,BLK 1770
* 5.400E-04, 5.400E-04, 5.400E-04, 5.400E-04, 5.700E-04, 0.000E-01,BLK 1780
* 6.000E-04, 6.000E-04, 6.000E-04, 6.000E-04, 6.000E-04, 6.100E-04,BLK 1790
* 0.000E-01, 6.700E-04, 6.700E-04, 6.700E-04, 6.700E-04, 6.700E-04,BLK 1800
* 6.600E-04, 0.000E-01, 3.600E-04, 3.600E-04, 3.600E-04, 3.600E-04,BLK 1810
* 3.600E-04, 3.800E-04, 0.000E-01, 1.100E-04, 1.100E-04, 1.100E-04,BLK 1820
* 1.100E-04, 1.100E-04, 1.600E-04, 0.000E-01, 4.300E-05, 4.300E-05,BLK 1830
* 4.300E-05, 4.300E-05, 4.300E-05, 6.700E-05, 0.000E-01, 1.900E-05,BLK 1840
* 1.900E-05, 1.900E-05, 1.900E-05, 1.900E-05, 3.200E-05, 0.000E-01,BLK 1850
* 6.300E-06, 6.300E-06, 6.300E-06, 6.300E-06, 6.300E-06, 1.200E-05,BLK 1860
* 0.000E-01, 1.400E-07, 1.400E-07, 1.400E-07, 1.400E-07, 1.400E-07,BLK 1870
* 1.500E-07, 0.000E-01, 1.000E-09, 1.000E-09, 1.000E-09, 1.000E-09/BLK 1880
 DATA WH3 /                                                        BLK 1890
* 1.000E-09, 1.000E-09, 0.000E-01, 0.000E-01, 0.000E-01, 0.000E-01,BLK 1900
* 0.000E-01, 0.000E-01, 0.000E-01, 0.000E-01/                      BLK 1910
 DATA WO1 /                                                        BLK 1920
* 5.600E-05, 6.000E-05, 6.000E-05, 4.900E-05, 4.100E-05, 5.400E-05,BLK 1930
* 0.000E-01, 5.600E-05, 6.000E-05, 5.400E-05, 5.400E-05, 4.100E-05,BLK 1940
* 5.400E-05, 0.000E-01, 5.400E-05, 6.000E-05, 4.900E-05, 5.600E-05,BLK 1950
* 4.100E-05, 5.400E-05, 0.000E-01, 5.100E-05, 6.200E-05, 4.900E-05,BLK 1960
* 5.800E-05, 4.300E-05, 5.000E-05, 0.000E-01, 4.700E-05, 6.400E-05,BLK 1970
* 4.900E-05, 6.000E-05, 4.500E-05, 4.600E-05, 0.000E-01, 4.500E-05,BLK 1980
* 6.600E-05, 5.800E-05, 6.400E-05, 4.700E-05, 4.600E-05, 0.000E-01,BLK 1990
* 4.300E-05, 6.900E-05, 6.400E-05, 7.100E-05, 4.900E-05, 4.500E-05,BLK 2000
* 0.000E-01, 4.100E-05, 7.500E-05, 7.700E-05, 7.500E-05, 7.100E-05,BLK 2010
* 4.900E-05, 0.000E-01, 3.900E-05, 7.900E-05, 9.000E-05, 7.900E-05,BLK 2020
* 9.000E-05, 5.200E-05, 0.000E-01, 3.900E-05, 8.600E-05, 1.200E-04,BLK 2030
* 1.100E-04, 1.600E-04, 7.100E-05, 0.000E-01, 3.900E-05, 9.000E-05,BLK 2040
* 1.600E-04, 1.300E-04, 2.400E-04, 9.000E-05, 0.000E-01, 4.100E-05,BLK 2050
* 1.100E-04, 2.100E-04, 1.800E-04, 3.200E-04, 1.300E-04, 0.000E-01,BLK 2060
* 4.300E-05, 1.200E-04, 2.600E-04, 2.100E-04, 4.300E-04, 1.600E-04,BLK 2070
* 0.000E-01, 4.500E-05, 1.500E-04, 3.000E-04, 2.600E-04, 4.700E-04,BLK 2080
* 1.700E-04, 0.000E-01, 4.500E-05, 1.800E-04, 3.200E-04, 2.800E-04,BLK 2090
* 4.900E-04, 1.900E-04, 0.000E-01, 4.700E-05, 1.900E-04, 3.400E-04,BLK 2100
* 3.200E-04, 5.600E-04, 2.100E-04, 0.000E-01, 4.700E-05, 2.100E-04/BLK 2110
 DATA WO2 /                                                        BLK 2120
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     * 3.600E-04, 3.400E-04, 6.200E-04, 2.400E-04, 0.000E-01, 6.900E-05,BLK 2130
     * 2.400E-04, 3.900E-04, 3.900E-04, 6.200E-04, 2.800E-04, 0.000E-01,BLK 2140
     * 9.000E-05, 2.800E-04, 4.100E-04, 4.100E-04, 6.200E-04, 3.200E-04,BLK 2150
     * 0.000E-01, 1.400E-04, 3.200E-04, 4.300E-04, 4.100E-04, 6.000E-04,BLK 2160
     * 3.500E-04, 0.000E-01, 1.900E-04, 3.400E-04, 4.500E-04, 3.900E-04,BLK 2170
     * 5.600E-04, 3.800E-04, 0.000E-01, 2.400E-04, 3.600E-04, 4.300E-04,BLK 2180
     * 3.600E-04, 5.100E-04, 3.800E-04, 0.000E-01, 2.800E-04, 3.600E-04,BLK 2190
     * 4.300E-04, 3.200E-04, 4.700E-04, 3.900E-04, 0.000E-01, 3.200E-04,BLK 2200
     * 3.400E-04, 3.900E-04, 3.000E-04, 4.300E-04, 3.800E-04, 0.000E-01,BLK 2210
     * 3.400E-04, 3.200E-04, 3.600E-04, 2.800E-04, 3.600E-04, 3.600E-04,BLK 2220
     * 0.000E-01, 3.400E-04, 3.000E-04, 3.400E-04, 2.600E-04, 3.200E-04,BLK 2230
     * 3.400E-04, 0.000E-01, 2.400E-04, 2.000E-04, 1.900E-04, 1.400E-04,BLK 2240
     * 1.500E-04, 2.000E-04, 0.000E-01, 9.200E-05, 9.200E-05, 9.200E-05,BLK 2250
     * 9.200E-05, 9.200E-05, 1.100E-04, 0.000E-01, 4.100E-05, 4.100E-05,BLK 2260
     * 4.100E-05, 4.100E-05, 4.100E-05, 4.900E-05, 0.000E-01, 1.300E-05,BLK 2270
     * 1.300E-05, 1.300E-05, 1.300E-05, 1.300E-05, 1.700E-05, 0.000E-01,BLK 2280
     * 4.300E-06, 4.300E-06, 4.300E-06, 4.300E-06, 4.300E-06, 4.000E-06,BLK 2290
     * 0.000E-01, 8.600E-08, 8.600E-08, 8.600E-08, 8.600E-08, 8.600E-08,BLK 2300
     * 8.600E-08, 0.000E-01, 4.300E-11, 4.300E-11, 4.300E-11, 4.300E-11/BLK 2310
      DATA WO3 /                                                       BLK 2320
     * 4.300E-11, 4.300E-11, 0.000E-01, 0.000E-01, 0.000E-01, 0.000E-01,BLK 2330
     * 0.000E-01, 0.000E-01, 0.000E-01, 0.000E-01/                     BLK 2340
C     HMIX(I)=HNO3 VOLUME MIXING RATIOS TIMES E+9 FROM EVANS  PROFILE  BLK 2350
      DATA HMIX/8*0.,1.E-30,0.1,0.33,0.8,1.2,1.4,1.6,1.8,1.9,2.0,2.1,2.3BLK 2360
     1,3.0,3.7,4.2,5.2,6.0,3.8,2.6,0.22,1.E-30,5*0.0/                  BLK 2370
      DATA  VSB              /23.,5.,23.,5.,5.,50.,23.,0.2,0.5/       BLK 2380
      DATA HZ(1)/8H   RURAL  /,HZ(2)/8H   RURAL  /,                    BLK 2390
     1HZ(3)/8HMARITIME  /,HZ(4)/8HMARITIME  /,HZ(5)/8H   URBAN  /,     BLK 2400
     2HZ(6)/8HTROPOSPH  /,HZ(7)/8HUSER DEF  /,HZ(8)/8HFOG1 (A)  /,    BLK 2410
     3HZ(9)/8HFOG2 (R)  /                                             BLK 2420
     4,HZ(10)/8HBACK STR  /,HZ(11)/8HAGED VOL  /,HZ(12)/8HFRESH VO  / BLK 2430
     4                     ,HZ(13)/8HAGED VOL  /,HZ(14)/8HFRESH VO  / BLK 2440
     5 ,HZ(15)/8HMET DUST   /                                         BLK 2450
      DATA SEASN(1)/8HSPRG SUM/,SEASN(2)/8HFAL WINT/                   BLK 2460
      DATA VULCN(1)/8HSTR BKGR/,VULCN(2)/8HAG V-MDV/,                  BLK 2470
     1VULCN(3)/8HFR V-HIV/,VULCN(4)/8HAG V-HIV/,VULCN(5)/8HFR V-MDV/   BLK 2480
C     DATA HMIX(9),HMIX(29)/2*1.E-30/                                  BLK 2490
C     SUBROUTINE PRFDTA                                                BLK 2500
C                                                                      BLK 2510
C        AEROSOL PROFILE DATA                                          BLK 2520
C                                                                      BLK 2530
      DATA ZHT              /                                          BLK 2540
     *    0.,    1.,    2.,    3.,    4.,    5.,    6.,    7.,    8., BLK 2550
     *    9.,   10.,   11.,   12.,   13.,   14.,   15.,   16.,   17., BLK 2560
     *   18.,   19.,   20.,   21.,   22.,   23.,   24.,   25.,   30., BLK 2570
     *   35.,   40.,   45.,   50.,   70.,  100.,99999./                BLK 2580
      DATA HZ2K/6.62E-02, 4.15E-02, 2.60E-02, 31*0.,                   BLK 2590
     *          1.58E-01, 9.91E-02, 6.21E-02, 31*0.,                   BLK 2600
     *          3.79E-01, 3.79E-01, 6.21E-02, 31*0.,                   BLK 2610
     *          7.70E-01, 7.70E-01, 6.21E-02, 31*0.,                   BLK 2620
     *          1.94E+00, 1.94E+00, 6.21E-02, 31*0./                   BLK 2630
      DATA FAWI50               /   3*0.,                              BLK 2640
     1 1.14E-02, 6.43E-03, 4.85E-03, 3.54E-03, 2.31E-03, 1.41E-03,     BLK 2650
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2 9.80E-04,24*0./                                                       BLK 2660
 DATA FAWI23              /   3*0.,                                     BLK 2670
1 2.72E-02, 1.20E-02, 4.85E-03, 3.54E-03, 2.31E-03, 1.41E-03,          BLK 2680
2 9.80E-04,24*0./                                                       BLK 2690
 DATA SPSU50              /    3*0.,                                    BLK 2700
1 1.46E-02, 1.02E-02, 9.31E-03, 7.71E-03, 6.23E-03, 3.37E-03,          BLK 2710
2 1.82E-03,24*0./                                                       BLK 2720
 DATA SPSU23              /   3*0.,                                     BLK 2730
1 3.46E-02, 1.85E-02, 9.31E-03, 7.71E-03, 6.23E-03, 3.37E-03,          BLK 2740
2 1.82E-03,24*0./                                                       BLK 2750
 DATA BASTFW              / 10*0.,                                      BLK 2760
1 7.87E-04, 7.14E-04, 6.64E-04, 6.23E-04, 6.45E-04, 6.43E-04,          BLK 2770
2 6.41E-04, 6.00E-04, 5.62E-04, 4.91E-04, 4.23E-04, 3.52E-04,          BLK 2780
3 2.95E-04, 2.42E-04, 1.90E-04, 1.50E-04, 3.32E-05,7*0./               BLK 2790
 DATA VUMOFW              /   10*0.,                                    BLK 2800
1 1.38E-03, 1.79E-03, 2.21E-03, 2.75E-03, 2.89E-03, 2.92E-03,          BLK 2810
2 2.73E-03, 2.46E-03, 2.10E-03, 1.71E-03, 1.35E-03, 1.09E-03,          BLK 2820
3 8.60E-04, 6.60E-04, 5.15E-04, 4.09E-04, 7.60E-05,7*0./               BLK 2830
 DATA HIVUFW              /   10*0.,                                    BLK 2840
1 1.71E-03, 2.31E-03, 3.25E-03, 4.52E-03, 6.40E-03, 7.81E-03,          BLK 2850
2 9.42E-03, 1.07E-02, 1.10E-02, 8.60E-03, 5.10E-03, 2.70E-03,          BLK 2860
3 1.46E-03, 8.90E-04, 5.80E-04, 4.09E-04, 7.60E-05,7*0./               BLK 2870
 DATA EXVUFW              /    10*0.,                                   BLK 2880
1 1.71E-03, 2.31E-03, 3.25E-03, 4.52E-03, 6.40E-03, 1.01E-02,          BLK 2890
2 2.35E-02, 6.10E-02, 1.00E-01, 4.00E-02, 9.15E-03, 3.13E-03,          BLK 2900
3 1.46E-03, 8.90E-04, 5.80E-04, 4.09E-04, 7.60E-05,7*0./               BLK 2910
 DATA BASTSS              /   10*0.,                                    BLK 2920
1 1.14E-03, 7.99E-04, 6.41E-04, 5.17E-04, 4.42E-04, 3.95E-04,          BLK 2930
2 3.82E-04, 4.25E-04, 5.20E-04, 5.81E-04, 5.89E-04, 5.02E-04,          BLK 2940
3 4.20E-04, 3.00E-04, 1.98E-04, 1.31E-04, 3.32E-05,7*0./               BLK 2950
 DATA VUMOSS              /    10*0.,                                   BLK 2960
1 1.85E-03, 2.12E-03, 2.45E-03, 2.80E-03, 2.89E-03, 2.92E-03,          BLK 2970
2 2.73E-03, 2.46E-03, 2.10E-03, 1.71E-03, 1.35E-03, 1.09E-03,          BLK 2980
3 8.60E-04, 6.60E-04, 5.15E-04, 4.09E-04, 7.60E-05,7*0./               BLK 2990
 DATA HIVUSS              /   10*0.,                                    BLK 3000
1 1.85E-03, 2.12E-03, 2.45E-03, 2.80E-03, 3.60E-03, 5.23E-03,          BLK 3010
2 8.11E-03, 1.20E-02, 1.52E-02, 1.53E-02, 1.17E-02, 7.09E-03,          BLK 3020
3 4.50E-03, 2.40E-03, 1.28E-03, 7.76E-04, 7.60E-05,7*0./               BLK 3030
 DATA EXVUSS              /   10*0.,                                    BLK 3040
1 1.85E-03, 2.12E-03, 2.45E-03, 2.80E-03, 3.60E-03, 5.23E-03,          BLK 3050
2 8.11E-03, 1.27E-02, 2.32E-02, 4.85E-02, 1.00E-01, 5.50E-02,          BLK 3060
3 6.10E-03, 2.40E-03, 1.28E-03, 7.76E-04, 7.60E-05,7*0./               BLK 3070
 DATA UPNATM              /  26*0.,                                     BLK 3080
1 3.32E-05, 1.64E-05, 7.99E-06, 4.01E-06, 2.10E-06, 1.60E-07,          BLK 3090
2 9.31E-10, 0.      /                                                   BLK 3100
 DATA VUTONO              / 26*0.,                                      BLK 3110
1 7.60E-05, 2.45E-05, 7.99E-06, 4.01E-06, 2.10E-06, 1.60E-07,          BLK 3120
2 9.31E-10, 0.      /                                                   BLK 3130
 DATA VUTOEX              /   26*0.,                                    BLK 3140
1 7.60E-05, 7.20E-05, 6.95E-05, 6.60E-05, 5.04E-05, 1.03E-05,          BLK 3150
2 4.50E-07, 0.      /                                                   BLK 3160
 DATA EXUPAT              /  26*0.,                                     BLK 3170
1 3.32E-05, 4.25E-05, 5.59E-05, 6.60E-05, 5.04E-05, 1.03E-05,          BLK 3180
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     2 4.50E-07, 0.      /                                                    BLK 3190
CCC         0-2KM                                                           BLK 3200
CCC           HZ2K=5 VIS PROFILES- 50KM,23KM,10KM,5KM,2KM                   BLK 3210
CCC         >2-9KM                                                          BLK 3220
CCC           FAWI50=FALL/WINTER   50KM VIS                                 BLK 3230
CCC           FAWI23=FALL/WINTER    23KM VIS                                BLK 3240
CCC           SPSU50=SPRING/SUMMER  50KM VIS                                BLK 3250
CCC           SPSU23=SPRING/SUMMER  23KM VIS                                BLK 3260
CCC         >9-30KM                                                         BLK 3270
CCC           BASTFW=BACKGROUND STRATOSPHERIC   FALL/WINTER                 BLK 3280
CCC           VUMOFW=MODERATE VOLCANIC          FALL/WINTER                 BLK 3290
CCC           HIVUFW=HIGH VOLCANIC              FALL/WINTER                 BLK 3300
CCC           EXVUFW=EXTREME VOLCANIC           FALL/WINTER                 BLK 3310
CCC           BASTSS,VUMOSS,HIVUSS,EXVUSS=      SPRING/SUMMER               BLK 3320
CCC         >30-100KM                                                       BLK 3330
CCC           UPNATM=NORMAL UPPER ATMOSPHERIC                               BLK 3340
CCC           VUTONO=TRANSITION FROM VOLCANIC TO NORMAL                     BLK 3350
CCC           VUTOEX=TRANSITION FROM VOLCANIC TO EXTREME                    BLK 3360
CCC           EXUPAT=EXTREME UPPER ATMOSPHERIC                              BLK 3370
CCC    READ IN AEROSOL MODELS   EXTINCTION AND ABSORPTION COEFFICIENTS       BLK 3380
C      SUBROUTINE EXTDTA                                                    BLK 3390
C                                                                           BLK 3400
C      AEROSOL EXTINCTION AND ABSORPTION DATA                               BLK 3410
C                                                                           BLK 3420
       DATA  VX2                  /                                         BLK 3430
      *   .2000,   .3000,   .3371,   .5500,   .6943,  1.0600,  1.5360,     BLK 3440
      *  2.0000,  2.2500,  2.5000,  2.7000,  3.0000,  3.3923,  3.7500,     BLK 3450
      *  4.5000,  5.0000,  5.5000,  6.0000,  6.2000,  6.5000,  7.2000,     BLK 3460
      *  7.9000,  8.2000,  8.7000,  9.0000,  9.2000, 10.0000, 10.5910,     BLK 3470
      * 11.0000, 11.5000, 12.5000, 14.8000, 15.0000, 16.4000, 17.2000,     BLK 3480
      * 18.5000, 21.3000, 25.0000, 30.0000, 40.0000/                       BLK 3490
       DATA  RURXT1               /                                         BLK 3500
      1 2.09291, 1.74582, 1.60500, 1.00000,  .75203,  .41943,  .24070,     BLK 3510
      2  .14709,  .13304,  .12234,  .13247,  .11196,  .10437,  .09956,     BLK 3520
      3  .09190,  .08449,  .07861,  .07025,  .07089,  .07196,  .07791,     BLK 3530
      4  .04481,  .04399,  .12184,  .12658,  .12829,  .09152,  .08076,     BLK 3540
      5  .07456,  .06880,  .06032,  .04949,  .05854,  .06000,  .06962,     BLK 3550
      6  .05722,  .06051,  .05177,  .04589,  .04304,                       BLK 3560
      1 2.09544, 1.74165, 1.59981, 1.00000,  .75316,  .42171,  .24323,     BLK 3570
      2  .15108,  .13608,  .12430,  .13222,  .13823,  .11076,  .10323,     BLK 3580
      3  .09475,  .08728,  .08076,  .07639,  .07797,  .07576,  .07943,     BLK 3590
      4  .04899,  .04525,  .12165,  .12741,  .12778,  .09032,  .07962,     BLK 3600
      5  .07380,  .06880,  .06329,  .05791,  .06646,  .06639,  .07443,     BLK 3610
      6  .06304,  .06443,  .05538,  .04867,  .04519/                       BLK 3620
       DATA RURXT2                /                                         BLK 3630
      1 2.07082, 1.71456, 1.57962, 1.00000,  .76095,  .43228,  .25348,     BLK 3640
      2  .16456,  .14677,  .13234,  .13405,  .20316,  .12873,  .11506,     BLK 3650
      3  .10481,  .09709,  .08918,  .09380,  .09709,  .08791,  .08601,     BLK 3660
      4  .06247,  .05601,  .11905,  .12595,  .12348,  .08741,  .07703,     BLK 3670
      5  .07266,  .07044,  .07443,  .08146,  .08810,  .08563,  .08962,     BLK 3680
      6  .08051,  .07677,  .06658,  .05747,  .05184,                       BLK 3690
      1 1.66076, 1.47886, 1.40139, 1.00000,  .80652,  .50595,  .32259,     BLK 3700
      2  .23468,  .20772,  .18532,  .17348,  .35114,  .20006,  .17386,     BLK 3710
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3  .16139,  .15424,  .14557,  .16215,  .16766,  .14994,  .14032,   BLK 3720
4  .12968,  .12601,  .13551,  .13582,  .13228,  .11070,  .09994,   BLK 3730
5  .09873,  .10418,  .13241,  .15924,  .16139,  .15949,  .15778,   BLK 3740
6  .15184,  .13848,  .12563,  .11076,  .09601/                     BLK 3750
 DATA  RURBS1                /                                     BLK 3760
1  .67196,  .11937,  .08506,  .05930,  .05152,  .05816,  .05006,   BLK 3770
2  .01968,  .02070,  .02101,  .05652,  .02785,  .01316,  .00867,   BLK 3780
3  .01462,  .01310,  .01627,  .02013,  .02165,  .02367,  .03538,   BLK 3790
4  .02823,  .03962,  .06778,  .07285,  .08120,  .04032,  .03177,   BLK 3800
5  .02557,  .02342,  .02177,  .02627,  .03943,  .03114,  .03696,   BLK 3810
6  .02956,  .03500,  .03241,  .03297,  .03380,                     BLK 3820
1  .62968,  .10816,  .07671,  .05380,  .04684,  .05335,  .04614,   BLK 3830
2  .01829,  .01899,  .01962,  .05525,  .06816,  .01652,  .00867,   BLK 3840
3  .01544,  .01373,  .01627,  .02892,  .02829,  .02532,  .03487,   BLK 3850
4  .02835,  .03854,  .06684,  .07272,  .08038,  .03987,  .03247,   BLK 3860
5  .02816,  .02816,  .03101,  .03741,  .04829,  .04032,  .04399,   BLK 3870
6  .03734,  .03956,  .03601,  .03525,  .03563/                     BLK 3880
 DATA RURBS2                 /                                     BLK 3890
1  .51899,  .08278,  .05816,  .04082,  .03570,  .04158,  .03620,   BLK 3900
2  .01513,  .01481,  .01633,  .05278,  .13690,  .02494,  .00886,   BLK 3910
3  .01804,  .01582,  .01677,  .04816,  .04367,  .03013,  .03443,   BLK 3920
4  .02930,  .03677,  .06209,  .06911,  .07475,  .03892,  .03494,   BLK 3930
5  .03513,  .03968,  .05152,  .06241,  .06937,  .06203,  .06215,   BLK 3940
6  .05614,  .05209,  .04608,  .04196,  .04095,                     BLK 3950
1  .21943,  .02848,  .01943,  .01342,  .01171,  .01437,  .01323,   BLK 3960
2  .01152,  .00696,  .01329,  .06108,  .24690,  .05323,  .01430,   BLK 3970
3  .03361,  .02949,  .02652,  .09437,  .08506,  .05348,  .04627,   BLK 3980
4  .04380,  .04557,  .05380,  .05715,  .05899,  .04861,  .05253,   BLK 3990
5  .06171,  .07437,  .10152,  .12019,  .12190,  .11734,  .11411,   BLK 4000
6  .10766,  .09487,  .08430,  .07348,  .06861/                     BLK 4010
 DATA  URBXT1                /                                     BLK 4020
1 1.88816, 1.63316, 1.51867, 1.00000,  .77785,  .47095,  .30006,   BLK 4030
2  .21392,  .19405,  .17886,  .18127,  .16133,  .14785,  .14000,   BLK 4040
3  .12715,  .11880,  .11234,  .10601,  .10500,  .10361,  .10342,   BLK 4050
4  .08766,  .08652,  .11937,  .12139,  .12297,  .09797,  .09057,   BLK 4060
5  .08595,  .08196,  .07563,  .06696,  .07209,  .06842,  .07177,   BLK 4070
6  .06354,  .06177,  .05373,  .04728,  .04051,                     BLK 4080
1 1.95582, 1.64994, 1.53070, 1.00000,  .77614,  .46639,  .29487,   BLK 4090
2  .21051,  .18943,  .17285,  .17209,  .21418,  .15354,  .14051,   BLK 4100
3  .12728,  .11861,  .11089,  .11329,  .11323,  .10563,  .10247,   BLK 4110
4  .08696,  .08361,  .12013,  .12418,  .12304,  .09614,  .08842,   BLK 4120
5  .08487,  .08285,  .08361,  .08430,  .08880,  .08449,  .08601,   BLK 4130
6  .07835,  .07323,  .06367,  .05500,  .04747/                     BLK 4140
 DATA URBXT2                 /                                     BLK 4150
1 1.96430, 1.64032, 1.52392, 1.00000,  .77709,  .46253,  .28690,   BLK 4160
2  .20310,  .17981,  .16101,  .15614,  .26475,  .15456,  .13563,   BLK 4170
3  .12215,  .11361,  .10500,  .11715,  .11753,  .10392,  .09766,   BLK 4180
4  .08443,  .08057,  .10943,  .11342,  .11063,  .08703,  .08025,   BLK 4190
5  .07886,  .08032,  .09101,  .10070,  .10386,  .09943,  .09886,   BLK 4200
6  .09152,  .08247,  .07152,  .06089,  .05253,                     BLK 4210
1 1.41266, 1.33816, 1.29114, 1.00000,  .83646,  .55025,  .35342,   BLK 4220
2  .25285,  .21576,  .18310,  .16215,  .37854,  .20494,  .16665,   BLK 4230
3  .14778,  .13892,  .12943,  .15525,  .15709,  .13513,  .12481,   BLK 4240
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4  .11759,  .11494,  .11487,  .11329,  .11108,  .09911,  .09209,   BLK 4250
5  .09342,  .10120,  .13177,  .15696,  .15766,  .15513,  .15203,   BLK 4260
6  .14532,  .13038,  .11785,  .10411,  .09101/                     BLK 4270
 DATA  URBBS1                 /                                    BLK 4280
1  .78437,  .58975,  .54285,  .36184,  .29222,  .20886,  .15658,   BLK 4290
2  .12329,  .11462,  .10747,  .11797,  .10025,  .08759,  .08184,   BLK 4300
3  .07506,  .07006,  .06741,  .06601,  .06544,  .06449,  .06665,   BLK 4310
4  .06278,  .06949,  .07316,  .07462,  .08101,  .05753,  .05272,   BLK 4320
5  .04899,  .04734,  .04494,  .04443,  .05133,  .04348,  .04443,   BLK 4330
6  .03994,  .03981,  .03633,  .03468,  .03146,                     BLK 4340
1  .69032,  .49367,  .45165,  .29741,  .24070,  .17399,  .13146,   BLK 4350
2  .10354,  .09589,  .09025,  .10411,  .15101,  .07880,  .06949,   BLK 4360
3  .06570,  .06095,  .05829,  .07171,  .06797,  .05975,  .06013,   BLK 4370
4  .05589,  .06051,  .07139,  .07494,  .07956,  .05525,  .05184,   BLK 4380
5  .05089,  .05291,  .05886,  .06380,  .06880,  .06127,  .06019,   BLK 4390
6  .05525,  .05070,  .04500,  .04076,  .03741/                     BLK 4400
 DATA URBBS2                  /                                    BLK 4410
1  .54848,  .37101,  .33734,  .21949,  .17785,  .12968,  .09854,   BLK 4420
2  .07804,  .07165,  .06791,  .08563,  .19639,  .06722,  .05316,   BLK 4430
3  .05316,  .04886,  .04620,  .07570,  .06899,  .05291,  .05101,   BLK 4440
4  .04734,  .05025,  .06171,  .06570,  .06854,  .04892,  .04797,   BLK 4450
5  .05057,  .05665,  .07127,  .08095,  .08411,  .07728,  .07475,   BLK 4460
6  .06886,  .06019,  .05222,  .04538,  .04171,                     BLK 4470
1  .15975,  .10000,  .09013,  .05785,  .04671,  .03424,  .02633,   BLK 4480
2  .02525,  .01975,  .02354,  .06241,  .26690,  .05810,  .02285,   BLK 4490
3  .03810,  .03386,  .03044,  .09627,  .08557,  .05405,  .04576,   BLK 4500
4  .04392,  .04424,  .04671,  .04791,  .04861,  .04684,  .05177,   BLK 4510
5  .06158,  .07475,  .10342,  .12146,  .12177,  .11734,  .11335,   BLK 4520
6  .10608,  .09171,  .08063,  .06968,  .06475/                     BLK 4530
 DATA  OCNXT1                 /                                    BLK 4540
1 1.47576, 1.32614, 1.26171, 1.00000,  .88133,  .70297,  .56487,   BLK 4550
2  .46006,  .42044,  .38310,  .35076,  .42266,  .32278,  .28810,   BLK 4560
3  .24905,  .21184,  .16734,  .14791,  .21532,  .15076,  .12057,   BLK 4570
4  .10038,  .10703,  .15070,  .15665,  .14639,  .10228,  .08367,   BLK 4580
5  .07373,  .06829,  .05044,  .04373,  .04962,  .06158,  .07703,   BLK 4590
6  .07234,  .06297,  .05481,  .05329,  .08741,                     BLK 4600
1 1.36924, 1.25443, 1.20835, 1.00000,  .91367,  .77089,  .64987,   BLK 4610
2  .54886,  .50247,  .45038,  .38209,  .50589,  .43766,  .38076,   BLK 4620
3  .31658,  .27475,  .22215,  .21019,  .27570,  .21057,  .16949,   BLK 4630
4  .14209,  .14215,  .16956,  .17082,  .16025,  .11665,  .09759,   BLK 4640
5  .09215,  .09373,  .10532,  .12570,  .13000,  .13633,  .14291,   BLK 4650
6  .13506,  .11475,  .09658,  .08291,  .10348/                     BLK 4660
 DATA OCNXT2                  /                                    BLK 4670
1 1.22259, 1.14627, 1.11842, 1.00000,  .94766,  .87538,  .80418,   BLK 4680
2  .72930,  .68582,  .62165,  .49962,  .67949,  .66468,  .59253,   BLK 4690
3  .49551,  .44671,  .37886,  .35924,  .43367,  .37019,  .30842,   BLK 4700
4  .26437,  .25228,  .24905,  .23975,  .22766,  .17804,  .15316,   BLK 4710
5  .15373,  .16791,  .22361,  .28348,  .28677,  .29082,  .29038,   BLK 4720
6  .27810,  .23867,  .20209,  .16430,  .14943,                     BLK 4730
1 1.09133, 1.06601, 1.05620, 1.00000,  .97506,  .94791,  .94203,   BLK 4740
2  .93671,  .92867,  .90411,  .80253,  .89222,  .94462,  .92146,   BLK 4750
3  .85797,  .82595,  .76747,  .68646,  .78209,  .75266,  .68658,   BLK 4760
4  .62722,  .60228,  .56335,  .53728,  .51861,  .43449,  .37196,   BLK 4770
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5  .35899,  .37316,  .46854,  .58234,  .58690,  .60348,  .60563,   BLK 4780
6  .60000,  .55392,  .50367,  .43576,  .35949/                     BLK 4790
 DATA  OCNBS1                /                                     BLK 4800
1  .30987,  .04354,  .02880,  .01797,  .01468,  .01766,  .01582,   BLK 4810
2  .00816,  .01146,  .01677,  .03310,  .03380,  .00715,  .00443,   BLK 4820
3  .00500,  .00601,  .00753,  .01595,  .02943,  .00994,  .01367,   BLK 4830
4  .01671,  .02538,  .03481,  .03405,  .03601,  .01608,  .01310,   BLK 4840
5  .01152,  .01082,  .01070,  .01563,  .02063,  .03171,  .03810,   BLK 4850
6  .03741,  .03804,  .03759,  .04209,  .07892,                     BLK 4860
1  .23367,  .03127,  .02070,  .01297,  .01063,  .01285,  .01190,   BLK 4870
2  .00937,  .00911,  .01576,  .05576,  .23487,  .03949,  .00905,   BLK 4880
3  .02057,  .01816,  .01665,  .08025,  .08044,  .03677,  .03139,   BLK 4890
4  .03190,  .03766,  .04532,  .04544,  .04715,  .03405,  .03614,   BLK 4900
5  .04329,  .05424,  .07823,  .09728,  .10057,  .10247,  .10222,   BLK 4910
6  .09551,  .08241,  .07158,  .06506,  .09203/                     BLK 4920
 DATA OCNBS2                 /                                     BLK 4930
1  .13025,  .01557,  .01013,  .00646,  .00532,  .00665,  .00722,   BLK 4940
2  .01335,  .00728,  .01810,  .09835,  .37329,  .09703,  .01968,   BLK 4950
3  .05114,  .04342,  .03709,  .17456,  .16468,  .08785,  .06880,   BLK 4960
4  .06589,  .06791,  .07247,  .07329,  .07449,  .07025,  .07962,   BLK 4970
5  .09899,  .12481,  .17867,  .22019,  .22228,  .22051,  .21595,   BLK 4980
6  .20335,  .17278,  .14677,  .12171,  .12430,                     BLK 4990
1  .03506,  .00323,  .00215,  .00139,  .00114,  .00171,  .00532,   BLK 5000
2  .03082,  .01101,  .03741,  .20101,  .47608,  .21165,  .05234,   BLK 5010
3  .12886,  .11215,  .09684,  .32810,  .31778,  .20513,  .16658,   BLK 5020
4  .15956,  .15842,  .15905,  .15968,  .16051,  .16506,  .18323,   BLK 5030
5  .21709,  .25652,  .33222,  .39639,  .39854,  .40297,  .40025,   BLK 5040
6  .39025,  .35468,  .32006,  .27715,  .25348/                     BLK 5050
 DATA  TROXT1                /                                     BLK 5060
1 2.21222, 1.82753, 1.67032, 1.00000,  .72424,  .35272,  .15234,   BLK 5070
2  .05165,  .03861,  .02994,  .04671,  .02462,  .01538,  .01146,   BLK 5080
3  .01032,  .00816,  .00861,  .00994,  .01057,  .01139,  .01747,   BLK 5090
4  .01494,  .02418,  .03165,  .03386,  .04247,  .01601,  .01215,   BLK 5100
5  .00937,  .00861,  .00823,  .01139,  .01924,  .01234,  .01348,   BLK 5110
6  .01114,  .01297,  .01266,  .01418,  .01487,                     BLK 5120
1 2.21519, 1.82266, 1.66557, 1.00000,  .72525,  .35481,  .15449,   BLK 5130
2  .05475,  .04044,  .03082,  .04620,  .05272,  .01867,  .01266,   BLK 5140
3  .01127,  .00886,  .00886,  .01449,  .01399,  .01228,  .01728,   BLK 5150
4  .01475,  .02285,  .03215,  .03494,  .04285,  .01652,  .01304,   BLK 5160
5  .01101,  .01120,  .01297,  .01753,  .02468,  .01741,  .01766,   BLK 5170
6  .01513,  .01557,  .01456,  .01532,  .01582/                     BLK 5180
 DATA TROXT2                 /                                     BLK 5190
1 2.19082, 1.79462, 1.64456, 1.00000,  .73297,  .36443,  .16278,   BLK 5200
2  .06468,  .04658,  .03399,  .04538,  .11892,  .02835,  .01646,   BLK 5210
3  .01386,  .01076,  .00968,  .02551,  .02222,  .01468,  .01690,   BLK 5220
4  .01437,  .01994,  .03127,  .03513,  .04076,  .01722,  .01513,   BLK 5230
5  .01519,  .01791,  .02538,  .03272,  .03816,  .03038,  .02886,   BLK 5240
6  .02551,  .02228,  .01937,  .01804,  .01791,                     BLK 5250
1 1.75696, 1.54829, 1.45962, 1.00000,  .77816,  .43139,  .21778,   BLK 5260
2  .11329,  .08101,  .05506,  .04943,  .25291,  .06816,  .03703,   BLK 5270
3  .02601,  .01968,  .01468,  .04962,  .04247,  .02234,  .01797,   BLK 5280
4  .01532,  .01633,  .02259,  .02487,  .02595,  .01728,  .01892,   BLK 5290
5  .02399,  .03247,  .05285,  .06462,  .06608,  .05930,  .05525,   BLK 5300
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6  .04861,  .03753,  .02968,  .02348,  .02165/                          BLK 5310
 DATA  TROBS1                /                                          BLK 5320
1  .69671,  .09905,  .06563,  .04101,  .03354,  .03627,  .02810,        BLK 5330
2  .00873,  .00918,  .00930,  .03215,  .01285,  .00513,  .00316,        BLK 5340
3  .00557,  .00494,  .00646,  .00867,  .00937,  .01025,  .01646,        BLK 5350
4  .01481,  .02418,  .02886,  .03070,  .04032,  .01494,  .01139,        BLK 5360
5  .00873,  .00816,  .00797,  .01133,  .01911,  .01215,  .01329,        BLK 5370
6  .01101,  .01291,  .01266,  .01418,  .01487,                          BLK 5380
1  .65000,  .08791,  .05816,  .03652,  .02994,  .03278,  .02557,        BLK 5390
2  .00810,  .00842,  .00867,  .03139,  .03949,  .00646,  .00316,        BLK 5400
3  .00595,  .00519,  .00646,  .01304,  .01247,  .01095,  .01620,        BLK 5410
4  .01449,  .02278,  .02930,  .03184,  .04063,  .01544,  .01234,        BLK 5420
5  .01044,  .01076,  .01272,  .01741,  .02462,  .01722,  .01747,        BLK 5430
6  .01506,  .01551,  .01456,  .01532,  .01582/                          BLK 5440
 DATA TROBS2                 /                                          BLK 5450
1  .52804,  .06367,  .04158,  .02633,  .02184,  .02443,  .01937,        BLK 5460
2  .00658,  .00646,  .00709,  .02949,  .10013,  .00968,  .00310,        BLK 5470
3  .00677,  .00582,  .00646,  .02361,  .01994,  .01266,  .01544,        BLK 5480
4  .01386,  .01968,  .02848,  .03203,  .03854,  .01620,  .01449,        BLK 5490
5  .01462,  .01747,  .02513,  .03253,  .03797,  .03019,  .02861,        BLK 5500
6  .02538,  .02215,  .01930,  .01797,  .01791,                          BLK 5510
1  .19829,  .01842,  .01215,  .00791,  .00665,  .00778,  .00652,        BLK 5520
2  .00361,  .00253,  .00399,  .02570,  .20690,  .01715,  .00316,        BLK 5530
3  .00873,  .00728,  .00658,  .04481,  .03525,  .01646,  .01405,        BLK 5540
4  .01310,  .01468,  .01956,  .02184,  .02367,  .01608,  .01816,        BLK 5550
5  .02342,  .03203,  .05234,  .06399,  .06538,  .05867,  .05456,        BLK 5560
6  .04810,  .03715,  .02949,  .02335,  .02158/                          BLK 5570
 DATA FG1EXT                 /                                          BLK 5580
1  .98519,  .99158,  .99089, 1.00000, 1.00576, 1.01747, 1.03177,        BLK 5590
2 1.04146, 1.04696, 1.05323, 1.05886, 1.04899, 1.06823, 1.07804,        BLK 5600
3 1.09272, 1.10367, 1.11684, 1.10430, 1.11367, 1.12899, 1.14987,        BLK 5610
4 1.17209, 1.18278, 1.20133, 1.21266, 1.21949, 1.22677, 1.15589,        BLK 5620
5 1.05684,  .98291, 1.01120, 1.10911, 1.11462, 1.14671, 1.16247,        BLK 5630
6 1.18544, 1.21582, 1.24614, 1.26842, 1.20500/                          BLK 5640
 DATA FG1ABS                 /                                          BLK 5650
1  .00013, 0.00000, 0.00000, 0.00000, 0.00000,  .00095,  .01513,        BLK 5660
2  .10861,  .03892,  .13272,  .47133,  .49696,  .45785,  .17918,        BLK 5670
3  .37373,  .34601,  .31867,  .55190,  .55025,  .49987,  .46342,        BLK 5680
4  .45943,  .45918,  .46089,  .46241,  .46386,  .47196,  .48905,        BLK 5690
5  .51468,  .53101,  .55266,  .58665,  .58899,  .60367,  .61158,        BLK 5700
6  .62335,  .64120,  .65627,  .66278,  .66392/                          BLK 5710
 DATA FG2EXT                 /                                          BLK 5720
1  .94791,  .96215,  .97063, 1.00000, 1.00937, 1.05177, 1.12519,        BLK 5730
2 1.29570, 1.39203, 1.41120, 1.04715, 1.10816, 1.43285, 1.45272,        BLK 5740
3 1.18709, 1.04367,  .82354,  .71747,  .92405,  .79342,  .60266,        BLK 5750
4  .47677,  .43171,  .36734,  .33259,  .31184,  .24139,  .21601,        BLK 5760
5  .24006,  .28816,  .42671,  .56861,  .57266,  .58089,  .57165,        BLK 5770
6  .54247,  .43981,  .34475,  .24905,  .19291/                          BLK 5780
 DATA FG2ABS                 /                                          BLK 5790
1 0.00000, 0.00000, 0.00000, 0.00000, 0.00000,  .00013,  .00247,        BLK 5800
2  .01987,  .00620,  .02323,  .17209,  .57930,  .19810,  .03475,        BLK 5810
3  .09639,  .08000,  .06582,  .34589,  .32703,  .17025,  .12633,        BLK 5820
4  .11816,  .11627,  .11519,  .11538,  .11601,  .12329,  .14468,        BLK 5830
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5  .18633,  .24057,  .35411,  .44886,  .45095,  .45215,  .44278,   BLK 5840
6  .41778,  .34430,  .27823,  .21063,  .17867/                     BLK 5850
 DATA BSTEXT          /                                            BLK 5860
1 1.48671, 1.55462, 1.51506, 1.00000,  .70633,  .28867,  .09994,   BLK 5870
2  .04184,  .02728,  .01848,  .01335,  .06513,  .08930,  .06532,   BLK 5880
3  .04766,  .04278,  .05810,  .05367,  .04392,  .03342,  .04456,   BLK 5890
4  .11867,  .14709,  .12734,  .09291,  .08778,  .05019,  .04070,   BLK 5900
5  .05734,  .03576,  .01975,  .01892,  .01956,  .03665,  .04152,   BLK 5910
6  .01715,  .01620,  .00835,  .00633,  .00589/                     BLK 5920
 DATA BSTABS          /                                            BLK 5930
1 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000,  .00019,   BLK 5940
2  .00127,  .00158,  .00291,  .00405,  .05880,  .08297,  .06019,   BLK 5950
3  .04519,  .04133,  .05703,  .05266,  .04304,  .03285,  .04437,   BLK 5960
4  .11816,  .14633,  .12639,  .09215,  .08722,  .04968,  .04044,   BLK 5970
5  .05709,  .03551,  .01962,  .01892,  .01949,  .03665,  .04146,   BLK 5980
6  .01709,  .01620,  .00835,  .00633,  .00589/                     BLK 5990
 DATA AVOEXT          /                                            BLK 6000
1 1.14880, 1.19171, 1.18013, 1.00000,  .84873,  .53019,  .27968,   BLK 6010
2  .14551,  .11070,  .08633,  .07184,  .06076,  .04506,  .03399,   BLK 6020
3  .02095,  .01538,  .01266,  .01019,  .00994,  .01044,  .01361,   BLK 6030
4  .01791,  .02278,  .02918,  .03108,  .03234,  .03456,  .03184,   BLK 6040
5  .02772,  .02475,  .01715,  .01563,  .01665,  .01646,  .01734,   BLK 6050
6  .01772,  .01076,  .01051,  .01133,  .01329/                     BLK 6060
 DATA AVOABS          /                                            BLK 6070
1  .44816,  .11259,  .08500,  .05272,  .04082,  .02449,  .01487,   BLK 6080
2  .01019,  .00867,  .00842,  .00842,  .00949,  .00741,  .00487,   BLK 6090
3  .00316,  .00335,  .00399,  .00449,  .00525,  .00665,  .01114,   BLK 6100
4  .01652,  .02177,  .02437,  .02506,  .02658,  .03006,  .02861,   BLK 6110
5  .02513,  .02285,  .01620,  .01532,  .01633,  .01620,  .01709,   BLK 6120
6  .01741,  .01057,  .01038,  .01127,  .01329/                     BLK 6130
 DATA FVOEXT          /                                            BLK 6140
1  .88715,  .92532,  .94013, 1.00000, 1.03013, 1.05975, 1.01171,   BLK 6150
2  .88677,  .82538,  .76361,  .71563,  .67424,  .60589,  .55057,   BLK 6160
3  .45222,  .37646,  .32316,  .25519,  .22728,  .20525,  .17810,   BLK 6170
4  .14481,  .14152,  .37639,  .44551,  .44405,  .42222,  .36462,   BLK 6180
5  .32551,  .27519,  .16728,  .10627,  .10861,  .10886,  .11665,   BLK 6190
6  .13127,  .10108,  .08557,  .06411,  .05741/                     BLK 6200
 DATA FVOABS          /                                            BLK 6210
1  .41582,  .22892,  .19108,  .14468,  .12475,  .09158,  .06601,   BLK 6220
2  .04943,  .04367,  .04342,  .04399,  .05076,  .04133,  .02829,   BLK 6230
3  .01924,  .01981,  .02297,  .02475,  .02778,  .03411,  .05335,   BLK 6240
4  .07133,  .08816,  .15342,  .18506,  .19354,  .20791,  .18449,   BLK 6250
5  .16101,  .13759,  .08456,  .06886,  .07278,  .07367,  .07956,   BLK 6260
6  .08785,  .06032,  .05747,  .05133,  .05323/                     BLK 6270
 DATA DMEEXT          /                                            BLK 6280
1 1.05019, 1.05880, 1.05259, 1.00000,  .94949,  .81456,  .66051,   BLK 6290
2  .54380,  .49133,  .44677,  .41671,  .38063,  .34778,  .32804,   BLK 6300
3  .29722,  .27506,  .25082,  .22620,  .21652,  .20253,  .17266,   BLK 6310
4  .14905,  .14234,  .14082,  .15057,  .16399,  .23608,  .24481,   BLK 6320
5  .27791,  .25076,  .15272,  .09601,  .09456,  .14576,  .12373,   BLK 6330
6  .18348,  .12190,  .12924,  .08538,  .04108/                     BLK 6340
 DATA DMEABS          /                                            BLK 6350
1  .00063,  .00152,  .00184,  .00506,  .00791,  .01829,  .03728,   BLK 6360
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     2  .06158,  .07538,  .08943,  .10051,  .11614,  .13310,  .14348,   BLK 6370
     3  .14633,  .13728,  .12462,  .11184,  .10709,  .10076,  .09006,   BLK 6380
     4  .08734,  .09000,  .10304,  .11905,  .13437,  .19551,  .20095,   BLK 6390
     5  .22494,  .18418,  .09285,  .06665,  .06823,  .12329,  .10551,   BLK 6400
     6  .16184,  .09835,  .10582,  .06759,  .03247/                     BLK 6410
CCC                                                                     BLK 6420
CCC   ALTITUDE REGIONS FOR AEROSOL EXTINCTION COEFFICIENTS              BLK 6430
CCC                                                                     BLK 6440
CCC                                                                     BLK 6450
CCC         0-2KM                                                       BLK 6460
CCC           REXT=RURAL EXTINCTION   RURABS=RURAL ABSORPTION           BLK 6470
CCC           URBEXT=URBAN EXTINCTION   URBABS=URBAN ABSORPTION         BLK 6480
CCC           OCNEXT=MARITIME EXTINCTION  OCNABS=MARITIME ABSORPTION    BLK 6490
CCC           TROEXT=TROPSPHER EXTINCTION  TROABS=TROPOSPHER ABSORPTION BLK 6500
CCC           FG1EXT=FOG1 .2KM VIS EXTINCTION  FG1ABS=FOG1 ABSORPTION   BLK 6510
CCC           FG2EXT=FOG2 .5KM VIS EXTINCTION  FG2ABS=FOG2 ABSORPTION   BLK 6520
CCC         >2-9KM                                                      BLK 6530
CCC           TROEXT=TROPOSPHER EXTINCTION  TROABS=TROPOSPHER ABSORPTIONBLK 6540
CCC         >9-30KM                                                     BLK 6550
CCC           BSTEXT=BACKGROUND STRATOSPHERIC EXTINCTION                BLK 6560
CCC           BSTABS=BACKGROUND STRATOSPHERIC ABSORPTION                BLK 6570
CCC           AVOEXT=AGED VOLCANIC EXTINCTION                           BLK 6580
CCC           AVOABS=AGED VOLCANIC ABSORPTION                           BLK 6590
CCC           FVOEXT=FRESH VOLCANIC EXTINCTION                          BLK 6600
CCC           FVOABS=FRESH VOLCANIC ABSORPTION                          BLK 6610
CCC         >30-100KM                                                   BLK 6620
CCC           DMEEXT=METEORIC DUST EXTINCTION                           BLK 6630
CCC           DMEABS=METEORIC DUST ABSORPTION                           BLK 6640
C     SUBROUTINE TRFN                                                   BLK 6650
C     LOWTRAN TRANSMITTANCE FUNCTIONS                                   BLK 6660
      DATA TR           /                                               BLK 6670
     1  .9990,  .9980,  .9960,  .9940,  .9920,  .9900,  .9800,  .9700,  BLK 6680
     2  .9600,  .9500,  .9400,  .9300,  .9200,  .9100,  .9000,  .8800,  BLK 6690
     3  .8600,  .8400,  .8200,  .8000,  .7800,  .7600,  .7400,  .7200,  BLK 6700
     4  .7000,  .6800,  .6600,  .6400,  .6200,  .6000,  .5800,  .5600,  BLK 6710
     5  .5400,  .5200,  .5000,  .4800,  .4600,  .4400,  .4200,  .4000,  BLK 6720
     6  .3800,  .3600,  .3400,  .3200,  .3000,  .2800,  .2600,  .2400,  BLK 6730
     7  .2200,  .2000,  .1800,  .1600,  .1400,  .1200,  .1000,  .0800,  BLK 6740
     8  .0600,  .0400,  .0300,  .0200,  .0150,  .0100,  .0080,  .0060,  BLK 6750
     9  .0040,  .0020,  .0010/                                          BLK 6760
      DATA FW           /                                               BLK 6770
     1-2.3468,-2.0362,-1.6990,-1.4815,-1.3279,-1.2007, -.7825, -.5229,  BLK 6780
     2 -.3468, -.1938, -.0655,  .0414,  .1553,  .2430,  .3324,  .4838,  BLK 6790
     3  .6128,  .7243,  .8261,  .9191, 1.0000, 1.0792, 1.1461, 1.2122,  BLK 6800
     4 1.2672, 1.3284, 1.3892, 1.4409, 1.4955, 1.5441, 1.5966, 1.6435,  BLK 6810
     5 1.6857, 1.7340, 1.7782, 1.8261, 1.8692, 1.9191, 1.9638, 2.0086,  BLK 6820
     6 2.0607, 2.1038, 2.1461, 2.1875, 2.2304, 2.2788, 2.3263, 2.3717,  BLK 6830
     7 2.4183, 2.4698, 2.5159, 2.5740, 2.6284, 2.6902, 2.7559, 2.8261,  BLK 6840
     8 2.9031, 3.0000, 3.0607, 3.1461, 3.2041, 3.2718, 3.3054, 3.3444,  BLK 6850
     9 3.3979, 3.4914, 3.5682/                                          BLK 6860
      DATA FO           /                                               BLK 6870
     1-1.6778,-1.3980,-1.1192, -.9508, -.8239, -.7258, -.4318, -.2366,  BLK 6880
     2 -.1074, 0.0000,  .0969,  .1761,  .2304,  .3010,  .3522,  .4624,  BLK 6890
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     3  .5563,  .6435,  .7243,  .7924,  .8573,  .9191,  .9731, 1.0253,  BLK 6900
     4 1.0719, 1.1173, 1.1614, 1.2095, 1.2480, 1.2900, 1.3263, 1.3617,  BLK 6910
     5 1.3979, 1.4393, 1.4698, 1.4983, 1.5314, 1.5682, 1.6021, 1.6335,  BLK 6920
     6 1.6721, 1.7076, 1.7482, 1.7924, 1.8325, 1.8865, 1.9395, 2.0000,  BLK 6930
     7 2.0607, 2.1206, 2.1903, 2.2552, 2.3385, 2.4313, 2.5185, 2.6435,  BLK 6940
     8 2.7853, 2.9777, 3.1072, 3.2553, 3.3617, 3.4771, 3.5563, 3.6233,  BLK 6950
     9 3.7076, 3.8325, 3.9345/                                          BLK 6960
C     SUBROUTINE C4DTA                                                  BLK 6970
C        N2 CONTINUUM                                                   BLK 6980
C     C4 LOCATION  1    V =  2080 CM-1                                  BLK 6990
C     C4 LOCATION  133  V =  2740 CM-1                                  BLK 7000
      DATA C4A                  /                                       BLK 7010
     1 2.93E-04, 3.86E-04, 5.09E-04, 6.56E-04, 8.85E-04, 1.06E-03,      BLK 7020
     2 1.31E-03, 1.73E-03, 2.27E-03, 2.73E-03, 3.36E-03, 3.95E-03,      BLK 7030
     3 5.46E-03, 7.19E-03, 9.00E-03, 1.13E-02, 1.36E-02, 1.66E-02,      BLK 7040
     4 1.96E-02, 2.16E-02, 2.36E-02, 2.63E-02, 2.90E-02, 3.15E-02,      BLK 7050
     5 3.40E-02, 3.66E-02, 3.92E-02, 4.26E-02, 4.60E-02, 4.95E-02,      BLK 7060
     6 5.30E-02, 5.65E-02, 6.00E-02, 6.30E-02, 6.60E-02, 6.89E-02,      BLK 7070
     7 7.18E-02, 7.39E-02, 7.60E-02, 7.84E-02, 8.08E-02, 8.39E-02,      BLK 7080
     8 8.70E-02, 9.13E-02, 9.56E-02, 1.08E-01, 1.20E-01, 1.36E-01,      BLK 7090
     9 1.52E-01, 1.60E-01, 1.69E-01, 1.60E-01, 1.51E-01, 1.37E-01,      BLK 7100
     $ 1.23E-01, 1.19E-01, 1.16E-01, 1.14E-01, 1.12E-01, 1.12E-01,      BLK 7110
     $ 1.11E-01, 1.11E-01, 1.12E-01, 1.14E-01, 1.13E-01, 1.12E-01,      BLK 7120
     $ 1.09E-01, 1.07E-01, 1.02E-01, 9.90E-02, 9.50E-02, 9.00E-02,      BLK 7130
     $ 8.65E-02, 8.20E-02, 7.65E-02, 7.05E-02, 6.50E-02, 6.10E-02,      BLK 7140
     $ 5.50E-02, 4.95E-02, 4.50E-02, 4.00E-02, 3.75E-02, 3.50E-02,      BLK 7150
     $ 3.10E-02, 2.65E-02, 2.50E-02, 2.20E-02, 1.95E-02, 1.75E-02,      BLK 7160
     $ 1.60E-02, 1.40E-02, 1.20E-02, 1.05E-02, 9.50E-03, 9.00E-03,      BLK 7170
     $ 8.00E-03, 7.00E-03, 6.50E-03, 6.00E-03, 5.50E-03, 4.75E-03,      BLK 7180
     $ 4.00E-03, 3.75E-03, 3.50E-03, 3.00E-03, 2.50E-03, 2.25E-03,      BLK 7190
     $ 2.00E-03, 1.85E-03, 1.70E-03, 1.60E-03, 1.50E-03, 1.50E-03/      BLK 7200
      DATA C4B                  /                                       BLK 7210
     1 1.54E-03, 1.50E-03, 1.47E-03, 1.34E-03, 1.25E-03, 1.06E-03,      BLK 7220
     2 9.06E-04, 7.53E-04, 6.41E-04, 5.09E-04, 4.04E-04, 3.36E-04,      BLK 7230
     3 2.86E-04, 2.32E-04, 1.94E-04, 1.57E-04, 1.31E-04, 1.02E-04,      BLK 7240
     4 8.07E-05/                                                        BLK 7250
C        4M  H2O CONTINUUM                                              BLK 7260
C     C5 LOCATION  1    V =  2350   CM-1                                BLK 7270
C     C5 LOCATION  15   V =  2420   CM-1                                BLK 7280
      DATA C5                   /                                       BLK 7290
     1 0.00,  .19,  .15,  .12,  .10,  .09,  .10,  .12,  .15,  .17,      BLK 7300
     2  .20,  .24,  .28,  .33, 0.00/                                    BLK 7310
C        OZONE U.V. + VISIBLE                                           BLK 7320
C     C8 LOCATION  1    V =  13000  CM-1                                BLK 7330
C     C8 LOCATION  56   V =  24200  CM-1                                BLK 7340
C        DV = 200  CM-1                                                 BLK 7350
C     C8 LOCATION  57   V =  27500  CM-1                                BLK 7360
C     C8 LOCATION  102  V =  50000  CM-1                                BLK 7370
C        DV = 500  CM-1                                                 BLK 7380
      DATA C8                   /                                       BLK 7390
     1 4.50E-03, 8.00E-03, 1.07E-02, 1.10E-02, 1.27E-02, 1.71E-02,      BLK 7400
     2 2.00E-02, 2.45E-02, 3.07E-02, 3.84E-02, 4.78E-02, 5.67E-02,      BLK 7410
     3 6.54E-02, 7.62E-02, 9.15E-02, 1.00E-01, 1.09E-01, 1.20E-01,      BLK 7420
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4 1.28E-01, 1.12E-01, 1.11E-01, 1.16E-01, 1.19E-01, 1.13E-01,      BLK 7430
5 1.03E-01, 9.24E-02, 8.28E-02, 7.57E-02, 7.07E-02, 6.58E-02,      BLK 7440
6 5.56E-02, 4.77E-02, 4.06E-02, 3.87E-02, 3.82E-02, 2.94E-02,      BLK 7450
7 2.05E-02, 1.80E-02, 1.91E-02, 1.66E-02, 1.17E-02, 7.70E-03,      BLK 7460
8 6.10E-03, 8.50E-03, 6.10E-03, 3.70E-03, 3.20E-03, 3.10E-03,      BLK 7470
9 2.55E-03, 1.98E-03, 1.40E-03, 8.25E-04, 2.50E-04, 0.      ,      BLK 7480
$ 0.      , 0.      , 5.65E-04, 2.04E-03, 7.35E-03, 2.03E-02,      BLK 7490
$ 4.98E-02, 1.18E-01, 2.46E-01, 5.18E-01, 1.02E+00, 1.95E+00,      BLK 7500
$ 3.79E+00, 6.65E+00, 1.24E+01, 2.20E+01, 3.67E+01, 5.95E+01,      BLK 7510
$ 8.50E+01, 1.26E+02, 1.68E+02, 2.06E+02, 2.42E+02, 2.71E+02,      BLK 7520
$ 2.91E+02, 3.02E+02, 3.03E+02, 2.94E+02, 2.77E+02, 2.54E+02,      BLK 7530
$ 2.26E+02, 1.96E+02, 1.68E+02, 1.44E+02, 1.17E+02, 9.75E+01,      BLK 7540
$ 7.65E+01, 6.04E+01, 4.62E+01, 3.46E+01, 2.52E+01, 2.00E+01,      BLK 7550
$ 1.57E+01, 1.20E+01, 1.00E+01, 8.80E+00, 8.30E+00, 8.60E+00/      BLK 7560
 END                                                               BLK 7570
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      SUBROUTINE C1DTA (C1LL,L)                                          C1D  :10
C        WATER VAPOR                                                     C1D   20
C     C1 LOCATION  1    V =  350  CM-1                                   C1D   30
C     C1 LOCATION  1770 V =  9195  CM-1                                  C1D   40
C     C1 LOCATION  1771 V =  9875  CM-1                                  C1D   50
C     C1 LOCATION  2355 V =  12795  CM-1                                 C1D   60
C     C1 LOCATION  2356 V =  12350  CM-1                                 C1D   70
C     C1 LOCATION  2580 V =  14520  CM-1                                 C1D   80
C     COMMON /C1/C1(2580)                                                C1D  :90
      DIMENSION C1(2580)                                                 C1D  :91
      DIMENSION C1A(190),C1B(190),C1C(190),C1D(190),C1E(190),C1F(190),   C1D  :92
     1 C1G(190),C1H(190),C1I(190),C1J(190),C1K(190),C1L(190),C1M(190),    C1D  :93
     2 C1N(110)                                                          C1D  :94
      EQUIVALENCE (C1,C1A),(C1(191),C1B),(C1(381),C1C),(C1(571),C1D),    C1D  :95
     1 (C1(761),C1E),(C1(951),C1F),(C1(1141),C1G),(C1(1331),C1H),        C1D  :96
     2 (C1(1521),C1I),(C1(1711),C1J),(C1(1901),C1K),(C1(2091),C1L),      C1D  :97
     3 (C1(2281),C1M),(C1(2471),C1N)                                     C1D  :98
C     DATA C1(I),I=   1, 190)                                            C1D :100
      DATA C1A/                                                          C1D :101
     1 3.93, 3.72, 3.54, 3.42, 3.37, 3.37, 3.36, 3.33, 3.25, 3.13,       C1D  110
     2 3.02, 2.96, 2.97, 3.00, 3.08, 3.12, 3.08, 3.03, 3.00, 3.01,       C1D  120
     3 3.03, 3.07, 3.05, 3.01, 2.94, 2.83, 2.71, 2.62, 2.58, 2.57,       C1D  130
     4 2.62, 2.67, 2.72, 2.71, 2.60, 2.46, 2.35, 2.26, 2.22, 2.23,       C1D  140
     5 2.19, 2.17, 2.17, 2.20, 2.26, 2.34, 2.42, 2.39, 2.20, 2.01,       C1D  150
     6 1.92, 1.83, 1.78, 1.79, 1.81, 1.84, 1.83, 1.80, 1.71, 1.51,       C1D  160
     7 1.39, 1.30, 1.25, 1.18, 1.19, 1.18, 1.21, 1.33, 1.47, 1.53,       C1D  170
     8 1.54, 1.36, 1.12,  .89,  .69,  .49,  .60,  .71,  .79,  .99,       C1D  180
     9  .86,  .73,  .53,  .43,  .51,  .52,  .67,  .73,  .80,  .83,       C1D  190
     $  .80,  .63,  .47,  .32, -.08, -.21, -.29, -.21, -.01,  .08,       C1D  200
     $  .16,  .09, -.03, -.21, -.37, -.35, -.30, -.31, -.37, -.42,       C1D  210
     $ -.48, -.42, -.40, -.39, -.43, -.77, -.83, -.88, -.79, -.60,       C1D  220
     $ -.50, -.42, -.39, -.38, -.37, -.40, -.51, -.67, -.82, -.58,       C1D  230
     $ -.40, -.32, -.21, -.09, -.18, -.16, -.19, -.28, -.33, -.35,       C1D  240
     $ -.28, -.22, -.10, -.05, -.11, -.13, -.27, -.27, -.18, -.06,       C1D  250
     $  .11,  .23,  .26,  .19,  .11, 0.00, -.09,  .02,  .08,  .12,       C1D  260
     $  .22,  .28,  .39,  .54,  .68,  .75,  .79,  .79,  .71,  .69,       C1D  270
     $  .76,  .88, 1.01, 1.16, 1.18, 1.14, 1.05, 1.02, 1.11, 1.23,       C1D  280
     $ 1.41, 1.75, 1.83, 1.99, 2.05, 2.03, 2.00, 1.96, 1.90, 1.86/       C1D  290
C     DATA(C1(I),I= 191, 380)/                                           C1D :300
      DATA C1B/                                                          C1D :301
     1 1.91, 2.08, 2.24, 2.41, 2.63, 2.68, 2.67, 2.73, 2.79, 2.81,       C1D  310
     2 2.91, 2.93, 3.02, 3.16, 3.23, 3.30, 3.34, 3.43, 3.57, 3.59,       C1D  320
     3 3.59, 3.58, 3.57, 3.61, 3.71, 3.71, 3.69, 3.64, 3.60, 3.68,       C1D  330
     4 3.80, 3.95, 4.05, 4.05, 4.02, 3.99, 3.96, 4.01, 4.13, 4.22,       C1D  340
     5 4.35, 4.49, 4.58, 4.62, 4.63, 4.61, 4.57, 4.56, 4.56, 4.53,       C1D  350
     6 4.49, 4.46, 4.40, 4.28, 4.14, 3.92, 3.63, 3.35, 3.16, 3.10,       C1D  360
     7 3.24, 3.47, 3.66, 3.80, 3.93, 4.00, 4.04, 4.15, 4.23, 4.31,       C1D  370
     8 4.35, 4.31, 4.23, 4.20, 4.24, 4.28, 4.35, 4.42, 4.42, 4.44,       C1D  380
     9 4.46, 4.40, 4.30, 4.22, 4.13, 4.07, 4.12, 4.19, 4.22, 4.23,       C1D  390
     $ 4.16, 4.04, 3.99, 3.94, 3.93, 3.91, 3.86, 3.83, 3.80, 3.78,       C1D  400
     $ 3.70, 3.54, 3.40, 3.30, 3.31, 3.42, 3.52, 3.52, 3.49, 3.41,       C1D  410
     $ 3.21, 3.14, 3.10, 3.08, 3.11, 2.98, 2.88, 2.78, 2.74, 2.76,       C1D  420
     $ 2.72, 2.76, 2.82, 2.85, 2.86, 2.75, 2.64, 2.60, 2.61, 2.64,       C1D  430
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     $ 2.56, 2.49, 2.37, 2.25, 2.14, 2.08, 2.11, 2.20, 2.31, 2.28,      C1D  440
     $ 2.15, 2.06, 1.98, 2.03, 2.05, 1.96, 1.84, 1.72, 1.64, 1.59,      C1D  450
     $ 1.57, 1.57, 1.60, 1.63, 1.51, 1.38, 1.07,  .91,  .87,  .92,      C1D  460
     $ 1.04, 1.01,  .92,  .84,  .92,  .97, 1.01, 1.06, 1.10, 1.06,      C1D  470
     $ 1.01,  .91,  .79,  .55,  .47,  .41,  .39,  .38,  .34,  .33,      C1D  480
     $  .36,  .43,  .48,  .45,  .38,  .27,  .21,  .22,  .29,  .37/      C1D  490
C     DATA(C1(I),I= 381, 570)/                                           C1D :500
      DATA C1C/                                                         C1D :501
     1  .38,  .37,  .29,  .19,  .13,  .11,  .03, -.05, -.12, -.24,      C1D  510
     2 -.31, -.39, -.43, -.50, -.59, -.68, -.73, -.80, -.92,-1.06,      C1D  520
     3-1.14,-1.22,-1.27,-1.28,-1.33,-1.32,-1.43,-1.51,-1.63,-1.74,      C1D  530
     4-1.82,-1.98,-2.09,-2.21,-2.21,-2.24,-2.27,-2.36,-2.51,-2.65,      C1D  540
     5-2.70,-2.63,-2.57,-2.56,-2.59,-2.67,-2.69,-2.67,-2.68,-2.62,      C1D  550
     6-2.52,-2.42,-2.29,-2.14,-2.00,-1.87,-1.71,-1.51,-1.39,-1.27,      C1D  560
     7-1.12,-1.01, -.89, -.75, -.68, -.57, -.47, -.42, -.32, -.27,      C1D  570
     8 -.26, -.19, -.13, -.11, -.01,  .05,  .08,  .17,  .25,  .31,      C1D  580
     9  .41,  .43,  .44,  .43,  .36,  .35,  .31,  .25,  .25,  .22,      C1D  590
     $  .21,  .33,  .49,  .65,  .76,  .71,  .51,  .30,  .13,  .10,      C1D  600
     $  .17,  .24,  .31,  .38,  .45,  .51,  .56,  .60,  .63,  .62,      C1D  610
     $  .63,  .64,  .66,  .69,  .76,  .75,  .74,  .70,  .62,  .53,      C1D  620
     $  .46,  .39,  .38,  .37,  .38,  .42,  .47,  .50,  .58,  .69,      C1D  630
     $  .67,  .62,  .64,  .68,  .76,  .90, 1.11, 1.13, 1.10,  .97,      C1D  640
     $  .98, 1.17, 1.38, 1.52, 1.70, 1.76, 1.84, 1.92, 1.90, 1.87,      C1D  650
     $ 1.91, 2.02, 2.13, 2.10, 2.18, 2.22, 2.25, 2.03, 2.01, 1.77,      C1D  660
     $ 1.93, 2.19, 2.28, 2.14, 2.15, 2.22, 2.01, 2.14, 2.26, 2.36,      C1D  670
     $ 2.51, 2.66, 2.73, 2.68, 2.69, 2.64, 2.22, 1.95, 1.61, 1.11,      C1D  680
     $  .88,  .83,  .89, 1.20, 1.62, 1.82, 1.99, 2.01, 2.14, 2.16/      C1D  690
C     DATA(C1(I),I= 571, 760)/                                           C1D :700
      DATA C1D/                                                         C1D :701
     1 2.21, 2.30, 2.33, 2.42, 2.50, 2.51, 2.49, 2.46, 2.42, 2.37,      C1D  710
     2 2.37, 2.33, 2.31, 2.43, 2.56, 2.61, 2.63, 2.60, 2.50, 2.38,      C1D  720
     3 2.41, 2.34, 2.31, 2.32, 2.40, 2.27, 2.32, 2.22, 2.09, 2.08,      C1D  730
     4 2.17, 2.41, 2.77, 2.68, 2.49, 2.29, 2.23, 2.42, 2.61, 2.58,      C1D  740
     5 2.49, 2.40, 2.39, 2.51, 2.60, 2.68, 2.68, 2.70, 2.82, 2.83,      C1D  750
     6 2.82, 2.81, 2.84, 2.86, 2.91, 2.96, 3.03, 3.08, 3.21, 3.30,      C1D  760
     7 3.40, 3.52, 3.49, 3.46, 3.51, 3.54, 3.56, 3.55, 3.57, 3.61,      C1D  770
     8 3.71, 3.80, 3.92, 3.99, 4.06, 4.02, 4.06, 4.12, 4.28, 4.30,      C1D  780
     9 4.22, 4.32, 4.42, 4.53, 4.64, 4.55, 4.40, 4.28, 4.32, 4.38,      C1D  790
     $ 4.37, 4.24, 4.13, 4.14, 4.20, 4.25, 4.32, 4.35, 4.31, 4.27,      C1D  800
     $ 4.25, 4.27, 4.31, 4.36, 4.41, 4.52, 4.59, 4.71, 4.79, 4.81,      C1D  810
     $ 4.73, 4.61, 4.42, 4.28, 4.08, 4.00, 3.88, 3.86, 3.92, 3.98,      C1D  820
     $ 4.12, 4.18, 4.31, 4.37, 4.42, 4.50, 4.53, 4.58, 4.59, 4.61,      C1D  830
     $ 4.61, 4.59, 4.53, 4.49, 4.44, 4.41, 4.40, 4.34, 4.30, 4.26,      C1D  840
     $ 4.09, 3.98, 3.87, 3.78, 3.77, 3.79, 3.75, 3.72, 3.62, 3.56,      C1D  850
     $ 3.51, 3.48, 3.32, 3.18, 3.07, 2.96, 2.87, 2.80, 2.68, 2.58,      C1D  860
     $ 2.59, 2.51, 2.59, 2.57, 2.50, 2.42, 2.32, 2.20, 2.12, 2.00,      C1D  870
     $ 1.92, 1.79, 1.63, 1.60, 1.69, 1.78, 2.04, 2.00, 1.81, 1.70,      C1D  880
     $ 1.63, 1.61, 1.60, 1.49, 1.14, 1.35, 1.64, 1.69, 1.70, 1.59/      C1D  890
C     DATA(C1(I),I= 761, 950)/                                           C1D :900
      DATA C1E/                                                         C1D :901
     1 1.45, 1.29, 1.19, 1.08, 1.02, 1.04, 1.10, 1.16, 1.20, 1.23,      C1D  910
     2 1.22, 1.08, 1.08, 1.06,  .89,  .93,  .73,  .58,  .54,  .77,      C1D  920
     3  .81,  .74,  .71,  .57,  .49,  .43,  .38,  .12,  .10,  .20,      C1D  930
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     4  .41,  .37,  .31,  .11, -.13, -.21, -.32, -.36, -.39, -.33,      C1D  940
     5 -.39, -.45, -.50, -.56, -.62, -.68, -.77, -.84, -.91,-1.00,      C1D  950
     6-1.11,-1.19,-1.28,-1.31,-1.39,-1.43,-1.48,-1.52,-1.57,-1.60,      C1D  960
     7-1.61,-1.60,-1.58,-1.51,-1.42,-1.32,-1.26,-1.16,-1.00, -.83,      C1D  970
     8 -.71, -.61, -.52, -.43, -.36, -.30, -.21, -.19, -.17, -.15,      C1D  980
     9 -.13, -.17, -.19, -.12, -.06, -.01, 0.00, -.11, -.23, -.32,      C1D  990
     $ -.44, -.51, -.48, -.47, -.42, -.40, -.40, -.39, -.37, -.35,      C1D 1000
     $ -.48, -.75,-1.13,-1.58,-1.80,-1.66,-1.52,-1.35,-1.19,-1.02,      C1D 1010
     $ -.88, -.66, -.65, -.63, -.62, -.66, -.73, -.79, -.88, -.84,      C1D 1020
     $ -.70, -.59, -.43, -.39, -.50, -.61, -.74, -.79, -.76, -.69,      C1D 1030
     $ -.62, -.59, -.52, -.48, -.48, -.42, -.39, -.38, -.33, -.29,      C1D 1040
     $ -.26, -.23, -.22, -.28, -.37, -.50, -.60, -.60, -.51, -.46,      C1D 1050
     $ -.42, -.43, -.45, -.35, -.24, -.14, -.08, -.08, 0.00,  .11,      C1D 1060
     $  .32,  .43,  .42,  .32,  .23,  .22,  .28,  .45,  .55,  .62,      C1D 1070
     $  .65,  .71,  .75,  .80,  .83,  .85,  .87,  .90,  .93, 1.00,      C1D 1080
     $ 1.04, 1.15, 1.22, 1.32, 1.31, 1.32, 1.33, 1.48, 1.78, 1.87/      C1D 1090
C     DATA(C1(I),I= 951,1140)/                                         C1D:1100
      DATA C1F/                                                       C1D:1101
     1 2.01, 1.92, 1.86, 1.89, 1.92, 1.98, 2.03, 2.39, 2.31, 2.48,      C1D 1110
     2 2.70, 2.71, 2.76, 2.78, 2.70, 2.77, 3.08, 2.94, 3.05, 2.94,      C1D 1120
     3 3.23, 3.20, 3.19, 3.32, 3.11, 3.41, 3.31, 3.36, 3.46, 3.36,      C1D 1130
     4 3.39, 3.50, 3.41, 3.22, 3.19, 2.98, 2.78, 2.98, 3.02, 2.82,      C1D 1140
     5 2.98, 2.86, 2.92, 2.92, 3.05, 3.22, 3.60, 3.78, 3.81, 3.96,      C1D 1150
     6 3.76, 3.62, 3.34, 3.08, 3.31, 3.16, 3.37, 3.41, 3.30, 3.33,      C1D 1160
     7 3.33, 3.51, 3.48, 3.43, 3.52, 3.31, 3.40, 3.58, 3.61, 3.49,      C1D 1170
     8 3.46, 3.42, 3.19, 3.18, 3.30, 3.00, 2.99, 3.21, 3.11, 3.14,      C1D 1180
     9 3.10, 2.72, 2.81, 2.95, 2.69, 2.73, 2.72, 2.47, 2.51, 2.60,      C1D 1190
     $ 2.42, 2.37, 2.73, 1.91, 1.87, 1.81, 1.78, 1.53, 1.51, 1.62,      C1D 1200
     $ 1.59, 1.50, 1.42, 1.32, 1.22, 1.12, 1.08, 1.02,  .97,  .92,      C1D 1210
     $  .90,  .87,  .84,  .82,  .79,  .78,  .76,  .75,  .72,  .71,      C1D 1220
     $  .71,  .70,  .69,  .67,  .61,  .59,  .52,  .48,  .41,  .39,      C1D 1230
     $  .38,  .33,  .32,  .30,  .30,  .30,  .29,  .28,  .27,  .26,      C1D 1240
     $  .25,  .23,  .22,  .21,  .20,  .18,  .14,  .13,  .06,  .01,      C1D 1250
     $ -.03, -.07, -.11, -.16, -.21, -.24, -.29, -.32, -.38, -.41,      C1D 1260
     $ -.45, -.50, -.54, -.61, -.69, -.76, -.84, -.90, -.97,-1.01,      C1D 1270
     $-1.10,-1.13,-1.19,-1.22,-1.28,-1.30,-1.33,-1.36,-1.39,-1.43,      C1D 1280
     $-1.48,-1.50,-1.52,-1.57,-1.61,-1.66,-1.70,-1.72,-1.78,-1.81/      C1D 1290
C     DATA(C1(I),I=1141,1330)/                                         C1D:1300
      DATA C1G/                                                       C1D:1301
     1-1.89,-1.92,-2.00,-2.08,-2.16,-2.24,-2.31,-2.40,-2.48,-2.54,      C1D 1310
     2-2.61,-2.71,-2.83,-2.95,-3.10,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1320
     3-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1330
     4-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1340
     5-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1350
     6-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1360
     7-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1370
     8-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1380
     9-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1390
     $-3.78,-3.33,-3.01,-2.82,-2.68,-2.49,-2.30,-2.13,-2.00,-1.81,      C1D 1400
     $-1.60,-1.41,-1.13, -.90, -.79, -.63, -.48, -.36, -.28, -.16,      C1D 1410
     $ -.06,  .08,  .20,  .28,  .41,  .54,  .69,  .80,  .92, 1.04,      C1D 1420
     $ 1.19, 1.19, 1.01,  .98, 1.02, 1.19, 1.29, 1.30, 1.29, 1.38,      C1D 1430
     $ 1.19, 1.39, 1.42, 1.43, 1.70, 1.62, 1.54, 1.41, 1.53, 1.86,      C1D 1440
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     $ 1.96, 1.97, 2.02, 2.01, 1.94, 1.94, 1.83, 2.03, 2.21, 2.42,      C1D 1450
     $ 2.30, 2.16, 2.02, 2.02, 2.02, 2.13, 1.90, 1.71, 2.01, 1.56,      C1D 1460
     $ 1.56, 1.51, 1.30, 1.63, 1.64, 1.67, 1.70, 2.22, 2.39, 2.38,      C1D 1470
     $ 2.30, 1.93, 2.39, 2.49, 2.52, 2.57, 2.21, 2.18, 2.40, 2.41,      C1D 1480
     $ 2.45, 2.51, 2.23, 2.49, 2.30, 2.61, 2.72, 2.52, 2.63, 2.56/      C1D 1490
C     DATA(C1(I),I=1331,1520)/                                           C1D:1500
      DATA C1H/                                                         C1D:1501
     1 2.51, 2.70, 2.62, 2.62, 2.80, 2.74, 2.79, 2.74, 2.70, 2.88,      C1D 1510
     2 2.81, 2.72, 2.76, 2.84, 2.92, 2.98, 2.88, 2.88, 3.02, 3.08,      C1D 1520
     3 3.26, 3.03, 3.14, 3.28, 3.03, 3.11, 3.15, 3.30, 3.31, 3.22,      C1D 1530
     4 3.00, 3.06, 3.34, 3.40, 3.37, 3.32, 3.08, 3.09, 3.09, 3.01,      C1D 1540
     5 3.07, 3.07, 3.31, 3.21, 3.31, 3.67, 3.58, 3.79, 3.70, 3.49,      C1D 1550
     6 3.39, 3.11, 3.13, 3.01, 3.10, 3.01, 3.18, 3.32, 3.43, 3.35,      C1D 1560
     7 3.40, 3.39, 3.39, 3.51, 3.54, 3.42, 3.50, 3.67, 3.59, 3.63,      C1D 1570
     8 3.66, 3.48, 3.39, 3.29, 3.31, 3.41, 3.23, 3.32, 3.12, 2.91,      C1D 1580
     9 2.91, 2.75, 2.78, 2.72, 2.62, 2.58, 2.32, 2.22, 2.00, 1.97,      C1D 1590
     $ 1.68, 1.62, 1.64, 1.53, 1.56, 1.51, 1.52, 1.48, 1.42, 1.42,      C1D 1600
     $ 1.40, 1.41, 1.43, 1.56, 1.52, 1.51, 1.52, 1.39, 1.39, 1.30,      C1D 1610
     $ 1.09, 1.16, 1.21, 1.20, 1.22, 1.20, 1.18, 1.20, 1.19, 1.17,      C1D 1620
     $ 1.10, 1.10, 1.09, 1.10, 1.11, 1.04,  .98,  .90,  .86,  .90,      C1D 1630
     $  .90,  .90,  .86,  .71,  .79,  .70,  .71,  .67,  .62,  .53,      C1D 1640
     $  .42,  .31,  .20,  .01, -.08, -.17, -.26, -.35, -.44, -.53,      C1D 1650
     $ -.63, -.73, -.83, -.93,-1.04,-1.14,-1.24,-1.34,-1.44,-1.54,      C1D 1660
     $-1.64,-1.74,-1.84,-1.94,-2.04,-2.14,-2.24,-2.34,-2.44,-2.54,      C1D 1670
     $-2.64,-2.74,-2.84,-2.94,-3.04,-3.14,-3.24,-3.34,-3.44,-3.54,      C1D 1680
     $-3.64,-3.74,-3.84,-3.94,-4.04,-5.00,-5.00,-5.00,-5.00,-5.00/      C1D 1690
C     DATA(C1(I),I=1521,1710)/                                           C1D:1700
      DATA C1I/                                                         C1D:1701
     1-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1710
     2-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1720
     3-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1730
     4-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1740
     5-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1750
     6-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1760
     7-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 1770
     8-4.15,-4.06,-3.97,-3.88,-3.79,-3.70,-3.61,-3.52,-3.43,-3.34,      C1D 1780
     9-3.25,-3.16,-3.07,-2.98,-2.89,-2.80,-2.71,-2.62,-2.53,-2.44,      C1D 1790
     $-2.35,-2.26,-2.18,-2.09,-2.00,-1.91,-1.82,-1.73,-1.64,-1.55,      C1D 1800
     $-1.46,-1.37,-1.28,-1.19,-1.10,-1.01, -.92, -.83, -.74, -.65,      C1D 1810
     $ -.56, -.47, -.38, -.29, -.20, -.14, -.09, -.02,  .03,  .10,      C1D 1820
     $  .17,  .22,  .30,  .35,  .41,  .45,  .42,  .40,  .43,  .46,      C1D 1830
     $  .50,  .59,  .71,  .84,  .93, 1.01, 1.06, 1.07, 1.02, 1.01,      C1D 1840
     $ 1.12, 1.23, 1.24, 1.28, 1.34, 1.43, 1.52, 1.56, 1.59, 1.56,      C1D 1850
     $ 1.51, 1.61, 1.50, 1.70, 1.82, 1.92, 1.94, 1.89, 1.81, 1.45,      C1D 1860
     $ 1.30, 1.28, 1.43, 1.50, 1.49, 1.55, 1.48, 1.32, 1.39, 1.53,      C1D 1870
     $ 1.82, 2.23, 2.61, 2.51, 2.20, 1.86, 1.61, 1.19, 1.32, 1.52,      C1D 1880
     $ 1.70, 1.90, 2.01, 1.92, 1.91, 2.12, 2.10, 2.01, 2.18, 1.99/      C1D 1890
C     DATA(C1(I),I=1711,1900)/                                           C1D:1900
      DATA C1J/                                                         C1D:1901
     1 2.11, 2.28, 2.21, 2.13, 2.00, 1.91, 1.92, 1.97, 1.88, 1.91,      C1D 1910
     2 1.91, 1.92, 1.93, 1.74, 1.61, 1.58, 1.27, 1.20, 1.18, 1.11,      C1D 1920
     3  .99,  .86,  .71,  .60,  .44,  .31,  .19,  .03, -.07, -.21,      C1D 1930
     4 -.35, -.49, -.64, -.79, -.94,-1.11,-1.24,-1.41,-1.57,-1.73,      C1D 1940
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     5-1.91,-2.09,-2.27,-2.45,-2.63,-2.81,-2.99,-3.18,-3.37,-3.56,      C1D 1950
     6-3.75,-3.94,-4.13,-4.31,-4.49,-4.66,-4.83,-4.99,-5.14,-5.28,      C1D 1960
     7-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.68,-4.26,      C1D 1970
     8-3.89,-3.57,-3.32,-3.11,-2.91,-2.89,-2.79,-2.74,-2.63,-2.47,      C1D 1980
     9-2.29,-2.20,-2.17,-2.23,-2.27,-2.32,-2.12,-2.08,-2.07,-2.07,      C1D 1990
     $-2.07,-1.98,-1.77,-1.70,-1.63,-1.60,-1.59,-1.43,-1.21,-1.15,      C1D 2000
     $-1.09,-1.13,-1.29,-1.19, -.98, -.93, -.87, -.91, -.88, -.71,      C1D 2010
     $ -.62, -.59, -.58, -.63, -.58, -.39, -.22, -.14, -.06, -.01,      C1D 2020
     $ -.01, -.08, -.20, -.16, -.02,  .18,  .32,  .42,  .37,  .23,      C1D 2030
     $  .12,  .15,  .28,  .43,  .59,  .58,  .53,  .44,  .39,  .38,      C1D 2040
     $  .35,  .23,  .26,  .19,  .08,  .10,  .18,  .27,  .38,  .43,      C1D 2050
     $  .32,  .37,  .58,  .64,  .87,  .98, 1.00, 1.02, 1.13, 1.08,      C1D 2060
     $ 1.08, 1.16, 1.16, 1.30, 1.41, 1.40, 1.32, 1.32, 1.37, 1.42,      C1D 2070
     $ 1.50, 1.42, 1.38, 1.36, 1.38, 1.49, 1.63, 1.62, 1.62, 1.70,      C1D 2080
     $ 1.68, 1.60, 1.56, 1.56, 1.63, 1.64, 1.56, 1.49, 1.49, 1.52/      C1D 2090
C     DATA(C1(I),I=1901,2090)/                                          C1D:2100
      DATA C1K/                                                        C1D:2101
     1 1.58, 1.62, 1.62, 1.61, 1.61, 1.62, 1.63, 1.71, 1.72, 1.70,      C1D 2110
     2 1.70, 1.67, 1.62, 1.66, 1.70, 1.67, 1.56, 1.49, 1.42, 1.38,      C1D 2120
     3 1.26, 1.20, 1.13, 1.14, 1.19, 1.29, 1.50, 1.72, 1.86, 1.78,      C1D 2130
     4 1.82, 1.88, 1.82, 1.89, 1.99, 2.00, 2.14, 2.04, 2.02, 2.02,      C1D 2140
     5 1.98, 1.90, 1.83, 1.81, 1.72, 1.69, 1.59, 1.50, 1.36, 1.20,      C1D 2150
     6  .98,  .63,  .43,  .29,  .16,  .05,  .02,  .03,  .03,  .01,      C1D 2160
     7 -.08, -.18, -.20, -.11, -.06, -.03, -.14, -.21, -.08, -.06,      C1D 2170
     8  .10,  .18,  .11,  .32,  .42,  .44,  .38,  .28,  .42,  .43,      C1D 2180
     9  .41,  .33,  .32,  .41,  .50,  .46,  .31,  .18,  .08,  .20,      C1D 2190
     $  .21,  .34,  .36,  .28,  .35,  .39,  .42,  .38,  .32,  .30,      C1D 2200
     $  .16, -.01, -.23, -.41, -.52, -.48, -.58, -.61, -.48, -.23,      C1D 2210
     $ -.03,  .21,  .36,  .39,  .47,  .44,  .40,  .51,  .59,  .53,      C1D 2220
     $  .69,  .57,  .48,  .52,  .62,  .59,  .55,  .50,  .32,  .26,      C1D 2230
     $  .11, -.08, -.10, -.16, -.43, -.62, -.88,-1.09,-1.16,-1.31,      C1D 2240
     $-1.45,-1.49,-1.78,-1.91,-2.01,-1.97,-1.97,-1.97,-1.97,-2.26,      C1D 2250
     $-2.20,-2.01,-1.99,-2.00,-2.04,-2.37,-2.49,-2.44,-2.36,-2.32,      C1D 2260
     $-2.19,-2.10,-2.25,-2.16,-2.36,-2.44,-2.40,-2.49,-2.48,-2.43,      C1D 2270
     $-2.40,-2.36,-2.40,-2.49,-2.59,-2.68,-2.89,-3.28,-3.51,-3.74,      C1D 2280
     $-3.97,-4.20,-4.43,-4.66,-4.89,-5.00,-5.00,-5.00,-5.00,-5.00/      C1D 2290
C     DATA(C1(I),I=2091,2280)/                                          C1D:2300
      DATA C1L/                                                        C1D:2301
     1-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 2310
     2-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 2320
     3-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 2330
     4-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 2340
     5-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C1D 2350
     6-5.00,-5.00,-5.00,-5.00,-5.00,-3.71,-3.56,-3.40,-3.21,-3.06,      C1D 2360
     7-2.90,-2.74,-2.60,-2.46,-2.32,-2.17,-2.03,-1.87,-1.79,-1.74,      C1D 2370
     8-1.83,-1.82,-1.71,-1.59,-1.49,-1.46,-1.46,-1.49,-1.49,-1.25,      C1D 2380
     9-1.24,-1.08, -.90,-1.06, -.91, -.91,-1.01, -.99, -.87, -.92,      C1D 2390
     $ -.79, -.42, -.54, -.38, -.42, -.48, -.34, -.27, -.17, -.28,      C1D 2400
     $ -.38, -.22, -.30, -.08, -.01, -.20,  .06,  .10,  .06,  .14,      C1D 2410
     $ -.12, -.02, -.02, -.13, -.11, -.10, -.06, -.05, -.04, -.10,      C1D 2420
     $ -.04, -.06, -.21, -.38, -.61, -.40, -.31, -.42, -.58, -.57,      C1D 2430
     $ -.54, -.24,  .11,  .51,  .81,  .79,  .62,  .26, -.31, -.67,      C1D 2440
     $ -.80, -.88, -.50, -.39, -.10,  .09,  .06,  .08,  .16,  .21,      C1D 2450
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     $  .13,  .32,  .35,  .51,  .60,  .51,  .51,  .40,  .40,  .43,      C1D 2460
     $  .42,  .33,  .43,  .34,  .22,  .13, -.11, -.31, -.31, -.41,      C1D 2470
     $ -.41, -.39, -.53, -.69, -.84, -.88,-1.01,-1.10,-1.19,-1.29,      C1D 2480
     $-1.45,-1.49,-1.67,-1.67,-1.51,-1.66,-1.60,-1.69,-1.83,-1.51/      C1D 2490
C     DATA(C1(I),I=2281,2470)/                                          C1D:2500
      DATA C1M/                                                        C1D:2501
     1-1.42,-1.40,-1.24,-1.38,-1.31,-1.30,-1.30,-1.28,-1.39,-1.33,      C1D 2510
     2-1.40,-1.35,-1.37,-1.39,-1.41,-1.49,-1.48,-1.56,-1.47,-1.46,      C1D 2520
     3-1.41,-1.42,-1.48,-1.41,-1.31,-1.15,-1.13,-1.20,-1.41,-1.88,      C1D 2530
     4-2.08,-2.08,-2.22,-2.35,-2.35,-1.98,-1.92,-1.78,-1.57,-1.69,      C1D 2540
     5-1.70,-1.70,-1.66,-1.84,-1.50,-1.56,-1.42,-1.29,-1.38,-1.28,      C1D 2550
     6-1.48,-1.58,-1.44,-1.53,-1.48,-1.48,-1.58,-1.58,-1.69,-1.79,      C1D 2560
     7-2.00,-2.16,-1.99,-2.23,-2.04,-2.04,-2.39,-2.74,-3.09,-3.44,      C1D 2570
     8-3.79,-4.14,-4.49,-4.84,-5.19,-2.46,-2.26,-1.99,-2.01,-2.14,      C1D 2580
     9-2.31,-2.15,-2.01,-1.99,-2.14,-2.41,-2.12,-1.99,-1.84,-1.79,      C1D 2590
     $-1.71,-1.78,-1.72,-1.68,-1.78,-1.52,-1.38,-1.29,-1.22, -.91,      C1D 2600
     $ -.90,-1.01, -.76, -.90, -.90, -.90,-1.19,-1.00, -.79, -.68,      C1D 2610
     $ -.68, -.73, -.85, -.85, -.61, -.61, -.48, -.51, -.92, -.83,      C1D 2620
     $ -.61, -.41, -.29, -.29, -.61, -.74, -.19, -.18, 0.00,  .19,      C1D 2630
     $ -.10,  .20,  .20,  .02,  .20, -.01,  .18,  .28,  .11, 0.00,      C1D 2640
     $ -.37, -.10,  .02,  .16,  .20, 0.00,  .09,  .09,  .09,  .07,      C1D 2650
     $  .22,  .11,  .11,  .21,  .09,  .21,  .20,  .37,  .28,  .07,      C1D 2660
     $  .09, -.29, -.69, -.69, -.74, -.88,-1.01, -.86, -.54, -.19,      C1D 2670
     $  .19,  .23,  .21,  .29,  .28,  .29,  .52,  .54,  .51,  .60,      C1D 2680
     $  .40,  .49,  .48,  .46,  .49,  .27,  .06, -.33, -.81,-1.17/      C1D 2690
C     DATA(C1(I),I=2471,2580)/                                          C1D:2700
      DATA C1N/                                                        C1D:2701
     1-1.11,-1.37,-1.52,-1.54,-1.94,-2.06,-2.06,-2.14,-1.96,-2.00,      C1D 2710
     2-2.00,-2.08,-2.23,-2.31,-2.31,-2.53,-2.31,-2.31,-2.31,-2.28,      C1D 2720
     3-2.34,-2.34,-1.91,-1.82,-1.69,-1.56,-1.84,-1.91,-1.75,-1.83,      C1D 2730
     4-1.76,-1.54,-1.98,-1.80,-1.68,-1.69,-1.56,-1.60,-1.71,-1.36,      C1D 2740
     5-1.36,-1.44,-1.48,-1.40,-1.48,-1.36,-1.45,-1.49,-1.85,-1.39,      C1D 2750
     6-1.23,-1.18,-1.18,-1.34,-1.36,-1.23,-1.23,-1.37,-1.30,-1.40,      C1D 2760
     7-1.28,-1.27,-1.37,-1.32,-1.32,-1.22,-1.28,-1.38,-1.69,-2.07,      C1D 2770
     8-2.42,-2.58,-2.58,-2.80,-2.58,-2.43,-1.88,-1.60,-1.26,-1.16,      C1D 2780
     9-1.23,-1.10,-1.23,-1.10, -.83, -.80, -.80, -.80, -.98, -.97,      C1D 2790
     $ -.97, -.91, -.92,-1.13,-1.24,-1.50,-1.89,-2.18,-2.32,-2.63,      C1D 2800
     $-3.91,-4.20,-4.49,-4.78,-5.07,-5.07,-5.07,-5.07,-5.07,-5.07/      C1D 2810
      C1LL=C1(L)                                                       C1D:2820
      RETURN                                                           C1D 2830
      END                                                              C1D 2840
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      SUBROUTINE C2DTA (C2L,L)                                          C2D   10
C        UNIFORMLY MIXED GASES                                          C2D   20
C     C2 LOCATION  1    V =  500    CM-1                               C2D   30
C     C2 LOCATION  1515 V =  8070    CM-1                              C2D   40
C     C2 LOCATION  1516 V =  12950    CM-1                             C2D   50
C     C2 LOCATION  1575 V =  13245  CM-1                               C2D   60
C     COMMON/C2/ C2(1575)                                              C2D  :70
      DIMENSION C2(1575)                                               C2D  :71
      DIMENSION C2A(190),C2B(190),C2C(190),C2D(190),C2E(190),C2F(190),  C2D  :72
     * C2G(190),C2H(190),C2I(55)                                       C2D  :73
      EQUIVALENCE (C2,C2A),(C2(191),C2B),(C2(381),C2C),(C2(571),C2D),  C2D  :74
     * (C2(761),C2E),(C2(951),C2F),(C2(1141),C2G),(C2(1331),C2H),      C2D  :75
     * (C2(1521),C2I)                                                  C2D  :76
C     DATA(C2(I),I=   1, 190)/                                         C2D  :80
      DATA C2A/                                                        C2D  :81
     1-4.25,-3.70,-3.20,-2.75,-1.90,-1.73,-1.51,-1.29,-1.11, -.91,     C2D   90
     2 -.71, -.51, -.30, -.06,  .22,  .49,  .76, 1.08, 1.29, 1.56,     C2D  100
     3 1.76, 1.91, 2.08, 2.23, 2.36, 2.51, 2.72, 2.90, 3.12, 3.37,     C2D  110
     4 3.56, 3.69, 3.79, 3.86, 3.88, 3.86, 3.73, 3.58, 3.38, 3.17,     C2D  120
     5 2.86, 2.73, 2.52, 2.31, 2.17, 2.01, 1.89, 1.77, 1.63, 1.47,     C2D  130
     6 1.21,  .92,  .53,  .23, -.17, -.53, -.74, -.81, -.84, -.88,     C2D  140
     7-1.00,-1.18,-1.42,-1.61,-1.86,-2.10,-2.29,-2.51,-2.72,-2.91,     C2D  150
     8-3.14,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,     C2D  160
     9-5.00,-2.68,-2.47,-2.19,-1.97,-1.71,-1.50,-1.32,-1.21,-1.13,     C2D  170
     $-1.09,-1.11,-1.10,-1.09,-1.01,-1.01,-1.11,-1.33,-1.66,-2.13,     C2D  180
     $-2.51,-2.83,-2.71,-2.39,-2.09,-1.78,-1.59,-1.33,-1.18,-1.01,     C2D  190
     $ -.96, -.91, -.90, -.87, -.80, -.79, -.86,-1.07,-1.28,-1.69,     C2D  200
     $-2.11,-2.74,-3.09,-3.50,-3.03,-2.58,-2.23,-1.89,-1.54,-1.28,     C2D  210
     $-1.13,-1.11,-1.16,-1.20,-1.23,-1.21,-1.17,-1.12,-1.15,-1.19,     C2D  220
     $-1.20,-1.17,-1.02, -.89, -.68, -.42, -.24, -.01,  .18,  .40,     C2D  230
     $  .57,  .77,  .96, 1.07, 1.13, 1.11, 1.08, 1.15, 1.27, 1.33,     C2D  240
     $ 1.44, 1.40, 1.13,  .89,  .63,  .54,  .65,  .78,  .81,  .86,     C2D  250
     $  .82,  .68,  .47,  .14, -.12, -.48, -.92,-1.43,-1.89,-2.32,     C2D  260
     $-2.81,-5.00,-5.00,-5.00,-3.14,-2.47,-2.00,-1.71,-1.59,-1.61/     C2D  270
C     DATA(C2(I),I= 191, 380)/                                         C2D  :280
      DATA C2B/                                                        C2D  :281
     1-1.69,-1.82,-1.87,-1.90,-1.94,-2.04,-2.10,-2.23,-2.32,-2.48,     C2D  290
     2-2.71,-2.88,-3.09,-2.99,-2.43,-2.00,-1.69,-1.42,-1.38,-1.49,     C2D  300
     3-1.70,-2.01,-2.41,-2.64,-2.63,-2.49,-2.38,-2.27,-2.16,-2.05,     C2D  310
     4-1.94,-1.83,-1.76,-1.71,-1.70,-1.72,-1.81,-1.92,-2.03,-2.27,     C2D  320
     5-2.61,-3.21,-4.01,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,     C2D  330
     6-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,     C2D  340
     7-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,     C2D  350
     8-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.30,-3.42,-3.17,-2.98,     C2D  360
     9-2.83,-2.71,-2.67,-2.67,-2.68,-2.58,-2.33,-2.01,-1.64,-1.32,     C2D  370
     $ -.97, -.76, -.63, -.59, -.60, -.63, -.69, -.87,-1.08,-1.26,     C2D  380
     $-1.53,-1.87,-1.91,-1.93,-2.02,-2.21,-2.48,-2.80,-3.08,-3.11,     C2D  390
     $-3.09,-2.93,-2.76,-2.39,-2.01,-1.69,-1.36, -.99, -.63, -.28,     C2D  400
     $ 0.00,  .08,  .11,  .12,  .12,  .07,  .01, -.08, -.23, -.40,     C2D  410
     $ -.51, -.53, -.57, -.60, -.61, -.73, -.81, -.95,-1.05,-1.02,     C2D  420
     $ -.91, -.68, -.41, -.09,  .18,  .41,  .76, 1.00, 1.18, 1.39,     C2D  430
     $ 1.51, 1.58, 1.68, 1.71, 1.80, 1.91, 2.02, 2.18, 2.32, 2.50,     C2D  440
     $ 2.61, 2.69, 2.81, 2.89, 2.96, 3.04, 3.14, 3.27, 3.41, 3.55,     C2D  450
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     $ 3.72, 3.90, 4.03, 4.22, 4.42, 4.61, 4.71, 4.73, 4.65, 4.63,      C2D  460
     $ 4.72, 4.78, 4.79, 4.50, 3.62, 3.28, 2.79, 2.30, 1.86, 1.35/      C2D  470
C     DATA(C2(I),I= 381, 570)/                                          C2D :480
      DATA C2C/                                                         C2D :481
     1  .62, -.24,-1.69,-2.18,-2.01,-1.79,-1.53,-1.32,-1.20,-1.15,      C2D  490
     2-1.12,-1.18,-1.25,-1.26,-1.20,-1.17,-1.20,-1.32,-1.54,-1.84,      C2D  500
     3-2.16,-2.30,-2.26,-2.01,-1.71,-1.36,-1.06, -.81, -.61, -.49,      C2D  510
     4 -.45, -.47, -.49, -.46, -.37, -.31, -.34, -.49, -.75,-1.11,      C2D  520
     5-1.43,-2.01,-2.60,-2.89,-2.87,-2.74,-2.51,-2.42,-2.38,-2.39,      C2D  530
     6-2.42,-2.46,-2.48,-2.49,-2.43,-2.43,-2.46,-2.53,-2.68,-2.74,      C2D  540
     7-2.82,-2.87,-2.83,-2.82,-2.79,-2.71,-2.66,-2.49,-2.40,-2.32,      C2D  550
     8-2.26,-2.23,-2.20,-2.09,-2.02,-1.96,-1.88,-1.84,-1.86,-1.86,      C2D  560
     9-1.87,-1.83,-1.79,-1.73,-1.68,-1.64,-1.69,-1.74,-1.79,-1.87,      C2D  570
     $-1.78,-1.63,-1.50,-1.37,-1.21,-1.00, -.83, -.69, -.53, -.41,      C2D  580
     $ -.30, -.19, -.09, -.04,  .02,  .10,  .16,  .18,  .23,  .26,      C2D  590
     $  .27,  .26,  .24,  .22,  .17,  .12,  .07, -.01, -.07, -.09,      C2D  600
     $  .32,  .72,  .91, 1.12, 1.03,  .67,  .18, -.11, -.38, -.29,      C2D  610
     $ -.17, -.08, 0.00,  .09,  .13,  .18,  .24,  .27,  .29,  .30,      C2D  620
     $  .29,  .26,  .23,  .21,  .13,  .09,  .02, -.04, -.18, -.32,      C2D  630
     $ -.51, -.72, -.98,-1.18,-1.50,-1.62,-1.81,-2.04,-2.29,-2.49,      C2D  640
     $-2.62,-2.87,-3.03,-3.21,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  650
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.01,-3.38,-3.01,-2.63,      C2D  660
     $-2.32,-2.09,-1.98,-1.94,-2.00,-2.14,-2.26,-2.20,-2.02,-1.82/      C2D  670
C     DATA(C2(I),I= 571, 760)/                                          C2D :680
      DATA C2D/                                                         C2D :681
     1-1.59,-1.43,-1.38,-1.46,-1.64,-1.90,-2.09,-2.54,-2.91,-3.28,      C2D  690
     2-3.61,-3.72,-3.64,-3.50,-3.41,-3.37,-3.30,-3.16,-3.01,-2.76,      C2D  700
     3-2.51,-2.20,-1.80,-1.49,-1.22, -.97, -.72, -.49, -.20,  .03,      C2D  710
     4  .20,  .36,  .51,  .61,  .67,  .83, 1.00, 1.22, 1.38, 1.56,      C2D  720
     5 1.70, 1.86, 2.01, 2.20, 2.31, 2.47, 2.61, 2.76, 2.92, 3.01,      C2D  730
     6 3.05, 3.02, 2.98, 2.98, 3.01, 3.03, 2.97, 2.78, 2.44, 2.13,      C2D  740
     7 1.83, 1.59, 1.49, 1.50, 1.67, 1.94, 2.22, 2.50, 2.71, 2.93,      C2D  750
     8 3.12, 3.18, 3.17, 3.15, 3.21, 3.26, 3.19, 2.98, 2.59, 2.14,      C2D  760
     9 1.70, 1.22,  .55, -.27,-1.09,-2.54,-3.00,-2.94,-2.78,-2.68,      C2D  770
     $-2.61,-2.60,-2.63,-2.60,-2.57,-2.53,-2.57,-2.64,-2.77,-3.04,      C2D  780
     $-3.38,-3.98,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  790
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  800
     $-5.00,-4.00,-3.73,-3.62,-3.59,-3.53,-3.56,-3.57,-3.53,-3.51,      C2D  810
     $-3.45,-3.37,-3.26,-3.21,-3.18,-3.27,-3.36,-3.60,-3.96,-5.00,      C2D  820
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  830
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  840
     $-5.00,-5.00,-5.00,-5.00,-4.62,-4.07,-3.89,-3.76,-3.67,-3.56,      C2D  850
     $-3.42,-3.35,-3.26,-3.18,-3.14,-3.11,-3.09,-3.10,-3.12,-3.23,      C2D  860
     $-3.30,-3.38,-3.37,-3.29,-3.14,-3.08,-3.00,-2.93,-2.89,-2.91/      C2D  870
C     DATA(C2(I),I= 761, 950)/                                          C2D :880
      DATA C2E/                                                         C2D :881
     1-3.00,-3.08,-3.16,-3.31,-3.48,-3.71,-3.98,-5.00,-5.00,-5.00,      C2D  890
     2-5.00,-4.52,-3.98,-3.69,-3.42,-3.18,-2.95,-2.77,-2.61,-2.48,      C2D  900
     3-2.41,-2.41,-2.40,-2.38,-2.34,-2.27,-2.21,-2.31,-2.48,-2.73,      C2D  910
     4-3.21,-4.13,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  920
     5-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D  930
     6-5.00,-5.00,-4.13,-4.02,-3.99,-3.96,-3.87,-3.73,-3.51,-3.29,      C2D  940
     7-3.13,-2.99,-2.84,-2.73,-2.69,-2.68,-2.69,-2.65,-2.62,-2.59,      C2D  950
```

```
     8-2.57,-2.62,-2.81,-3.04,-3.21,-3.39,-3.42,-3.36,-3.21,-3.03,      C2D  960
     9-2.93,-2.80,-2.64,-2.52,-2.37,-2.28,-2.20,-2.13,-2.07,-2.02,      C2D  970
     $-1.96,-1.88,-1.78,-1.63,-1.44,-1.31,-1.20,-1.08, -.98, -.94,      C2D  980
     $ -.86, -.76, -.52, -.31, -.08,  .13,  .30,  .37,  .36,  .36,      C2D  990
     $  .35,  .35,  .39,  .46,  .48,  .41,  .23, -.08, -.38, -.67,      C2D 1000
     $ -.88, -.96, -.98, -.87, -.67, -.36, -.12,  .14,  .44,  .68,      C2D 1010
     $  .90, 1.11, 1.19, 1.24, 1.25, 1.26, 1.27, 1.51, 1.59, 1.50,      C2D 1020
     $ 1.28,  .71,  .11, -.28, -.67,-1.32,-1.61,-1.58,-1.42,-1.18,      C2D 1030
     $ -.91, -.59, -.27, -.06,  .29,  .57,  .73,  .92,  .81,  .73,      C2D 1040
     $  .79,  .91, 1.01, 1.03,  .88,  .72,  .63,  .38,  .12, -.21,      C2D 1050
     $ -.47, -.67,-1.23,-1.67,-2.31,-2.76,-3.24,-3.49,-3.51,-3.47,      C2D 1060
     $-3.39,-3.37,-3.43,-3.53,-3.50,-3.36,-3.18,-3.07,-2.96,-3.08/      C2D 1070
C     DATA(C2(I),I= 951,1140)/                                          C2D:1080
      DATA C2F/                                                        C2D:1081
     1-3.14,-3.12,-3.23,-3.07,-2.83,-2.47,-2.23,-2.07,-1.91,-1.78,      C2D 1090
     2-1.63,-1.46,-1.27,-1.23,-1.26,-1.40,-1.57,-1.98,-2.28,-2.87,      C2D 1100
     3-3.74,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1110
     4-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1120
     5-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1130
     6-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1140
     7-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1150
     8-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1160
     9-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1170
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1180
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1190
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1200
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1210
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1220
     $-5.00,-5.00,-4.91,-4.79,-4.61,-4.48,-4.40,-4.29,-4.17,-3.90,      C2D 1230
     $-3.73,-3.59,-3.62,-3.72,-3.73,-3.69,-3.31,-3.12,-2.91,-2.63,      C2D 1240
     $-2.41,-2.27,-2.16,-2.11,-2.28,-2.29,-2.21,-2.06,-1.91,-1.99,      C2D 1250
     $-2.27,-2.59,-2.98,-3.35,-3.69,-3.79,-3.68,-3.53,-3.46,-3.39,      C2D 1260
     $-3.31,-3.18,-2.97,-2.69,-2.39,-2.11,-1.83,-1.58,-1.49,-1.22/      C2D 1270
C     DATA(C2(I),I=1141,1330)/                                          C2D:1280
      DATA C2G/                                                        C2D:1281
     1-1.08, -.89, -.68, -.54, -.71, -.79, -.78, -.66, -.49, -.54,      C2D 1290
     2 -.86,-1.37,-2.08,-2.44,-3.46,-3.72,-3.74,-3.59,-3.22,-2.98,      C2D 1300
     3-2.52,-2.21,-1.64,-1.34,-1.08, -.86, -.72, -.61, -.70, -.72,      C2D 1310
     4 -.67, -.57, -.38, -.51, -.97,-1.36,-1.89,-2.74,-3.18,-4.21,      C2D 1320
     5-4.57,-4.62,-4.78,-4.87,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1330
     6-4.93,-4.46,-3.99,-3.45,-2.99,-2.63,-2.30,-2.09,-2.02,-2.12,      C2D 1340
     7-2.18,-2.13,-2.04,-1.78,-1.83,-2.08,-2.28,-2.81,-3.01,-3.15,      C2D 1350
     8-3.22,-3.29,-3.58,-3.89,-4.46,-4.88,-5.00,-5.00,-5.00,-5.00,      C2D 1360
     9-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1370
     $-4.81,-4.52,-4.11,-3.69,-3.09,-2.99,-2.91,-2.89,-3.19,-3.20,      C2D 1380
     $-3.36,-3.62,-3.89,-3.92,-3.73,-3.53,-3.37,-3.19,-3.02,-2.79,      C2D 1390
     $-2.52,-2.36,-2.24,-2.19,-2.32,-2.41,-2.29,-2.06,-2.00,-2.18,      C2D 1400
     $-2.47,-2.91,-3.57,-4.89,-5.00,-5.00,-5.00,-5.00,-5.00,-4.61,      C2D 1410
     $-4.18,-3.89,-3.57,-3.30,-3.02,-2.74,-2.51,-2.20,-1.98,-1.73,      C2D 1420
     $-1.57,-1.38,-1.21,-1.11, -.98, -.87, -.78, -.60, -.37, -.18,      C2D 1430
     $ -.04, -.04, -.06, -.16, -.18, -.19, -.23, -.45,-1.02,-1.97,      C2D 1440
     $-2.70,-3.71,-4.01,-4.20,-4.35,-4.58,-4.73,-4.81,-5.00,-5.00,      C2D 1450
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1460
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     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00/      C2D 1470
C     DATA(C2(I),I=1331,1520)/                                          C2D:1480
      DATA C2H/                                                         C2D:1481
     1-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1490
     2-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1500
     3-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1510
     4-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1520
     5-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1530
     6-5.00,-5.00,-5.00,-4.71,-4.31,-3.99,-3.68,-3.50,-3.34,-3.22,      C2D 1540
     7-3.23,-3.25,-3.24,-3.18,-3.10,-3.07,-3.18,-3.41,-3.67,-4.12,      C2D 1550
     8-4.68,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.51,-4.18,      C2D 1560
     9-3.73,-3.48,-3.17,-2.96,-2.73,-2.63,-2.58,-2.59,-2.57,-2.49,      C2D 1570
     $-2.42,-2.38,-2.48,-2.62,-3.02,-3.49,-4.16,-5.00,-5.00,-5.00,      C2D 1580
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.87,-4.50,      C2D 1590
     $-4.21,-3.90,-3.66,-3.56,-3.51,-3.51,-3.51,-3.49,-3.41,-3.34,      C2D 1600
     $-3.34,-3.47,-3.60,-3.87,-4.23,-4.59,-5.00,-5.00,-5.00,-5.00,      C2D 1610
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.93,      C2D 1620
     $-4.51,-4.10,-3.78,-3.32,-3.03,-2.74,-2.43,-2.08,-1.83,-1.59,      C2D 1630
     $-1.29,-1.02, -.81, -.70, -.73, -.90,-1.08,-1.19,-1.35,-1.47,      C2D 1640
     $-1.57,-1.66,-1.80,-1.91,-2.04,-2.18,-2.33,-2.47,-2.61,-2.78,      C2D 1650
     $-2.97,-3.10,-3.28,-3.44,-3.63,-3.81,-3.98,-4.15,-4.32,-4.61,      C2D 1660
     $-4.71,-4.80,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.32/      C2D 1670
C     DATA(C2(I),I=1521,1575)/                                          C2D:1680
      DATA C2I/                                                         C2D:1681
     1-3.24,-2.59,-2.12,-1.82,-1.57,-1.34,-1.16,-1.02, -.82, -.64,      C2D 1690
     2 -.48, -.33, -.14, -.06,  .08,  .21,  .39,  .52,  .61,  .72,      C2D 1700
     3  .85,  .96, 1.02, 1.12, 1.18, 1.21, 1.17, 1.08,  .98,  .90,      C2D 1710
     4  .97, 1.13, 1.37, 1.58, 1.74, 1.70, 1.48, 1.13,  .73,  .22,      C2D 1720
     5 -.51,-1.57,-3.48,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C2D 1730
     6-5.00,-5.00,-5.00,-5.00,-5.00/                                    C2D 1740
      C2L=C2(L)                                                         C2D 1750
      RETURN                                                            C2D 1760
      END                                                               C2D 1770
```

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      SUBROUTINE C3DTA (C3L,L)                                          C3D   10
C        OZONE                                                          C3D   20
C     C3 LOCATION  1    V =  575   CM-1                                 C3D   30
C     C3 LOCATION  510  V =  3270 CM-1                                  C3D   40
C     COMMON /C3/ C3(540)                                               C3D   50
      DIMENSION C3(540),C3A(190),C3B(190),C3C(160)                      C3D  :51
      EQUIVALENCE (C3,C3A),(C3(191),C3B),(C3(381),C3C)                  C3D  :52
C     DATA(C3(I),I=   1, 190)/                                          C3D  :60
      DATA C3A/                                                         C3D  :61
     1-4.15,-3.51,-3.00,-2.54,-2.12,-1.76,-1.50,-1.21, -.86, -.49,      C3D   70
     2 -.29, -.10,  .02,  .12,  .24,  .32,  .43,  .52,  .58,  .65,      C3D   80
     3  .72,  .79,  .76,  .72,  .68,  .64,  .68,  .79,  .83,  .83,      C3D   90
     4  .80,  .78,  .68,  .56,  .49,  .42,  .34,  .26,  .14,  .02,      C3D  100
     5 -.14, -.35, -.51, -.74, -.88,-1.17,-1.40,-1.58,-2.11,-2.47,      C3D  110
     6-2.83,-3.24,-3.59,-3.94,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  120
     7-5.00,-5.00,-5.00,-5.00,-5.00,-4.46,-4.00,-3.50,-3.14,-2.78,      C3D  130
     8-2.41,-2.10,-1.78,-1.49,-1.20, -.20,  .15,  .35,  .57,  .78,      C3D  140
     9  .95, 1.20, 1.40, 1.65, 1.80, 1.97, 2.10, 2.21, 2.31, 2.38,      C3D  150
     $ 2.40, 2.42, 2.58, 2.52, 2.20, 2.48, 2.54, 2.45, 2.30, 2.00,      C3D  160
     $ 1.20,  .95,  .92,  .90,  .90,  .89,  .90,  .92,  .94,  .95,      C3D  170
     $  .96,  .95,  .90,  .80,  .68,  .55,  .40,  .30,  .19,  .08,      C3D  180
     $ -.02, -.11, -.22, -.41, -.56, -.71, -.89,-1.03,-1.18,-1.33,      C3D  190
     $-1.60,-1.76,-1.90,-2.02,-2.21,-2.46,-2.59,-2.79,-3.00,-3.22,      C3D  200
     $-3.61,-4.16,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  210
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  220
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  230
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  240
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00/      C3D  250
C     DATA(C3(I),I= 191, 380)/                                          C3D  :260
      DATA C3B/                                                         C3D  :261
     1-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  270
     2-5.00,-5.00,-5.00,-5.00,-4.16,-3.91,-3.66,-3.41,-3.05,-2.69,      C3D  280
     3-2.44,-2.19,-2.03,-1.86,-1.71,-1.56,-1.48,-1.39,-1.26,-1.13,      C3D  290
     4 -.97, -.81, -.65, -.48, -.35, -.22, -.14, -.06, -.02, -.09,      C3D  300
     5 -.18, -.14,  .06,  .26, -.02, -.42, -.80, -.82, -.80, -.74,      C3D  310
     6 -.74, -.79, -.84, -.89, -.85, -.81, -.76, -.70, -.68, -.64,      C3D  320
     7 -.65, -.66, -.72, -.78, -.84, -.90,-1.02,-1.14,-1.24,-1.33,      C3D  330
     8-1.47,-1.61,-1.77,-1.92,-1.98,-2.04,-2.08,-2.09,-2.06,-2.03,      C3D  340
     9-1.98,-1.93,-1.87,-1.82,-1.76,-1.71,-1.65,-1.59,-1.51,-1.44,      C3D  350
     $-1.36,-1.28,-1.18,-1.08, -.98, -.88, -.78, -.69, -.59, -.49,      C3D  360
     $ -.37, -.25, -.18, -.10, 0.00,  .16,  .27,  .38,  .57,  .75,      C3D  370
     $  .93, 1.11, 1.20, 1.33, 1.44, 1.46, 1.48, 1.48, 1.64, 1.58,      C3D  380
     $ 1.49, 1.23,  .66,  .38, -.33, -.71, -.66, -.58, -.49, -.44,      C3D  390
     $ -.40, -.40, -.46, -.53, -.64, -.76, -.89,-1.01,-1.14,-1.26,      C3D  400
     $-1.40,-1.55,-1.69,-1.83,-1.98,-2.13,-2.28,-2.43,-2.64,-2.86,      C3D  410
     $-3.07,-3.28,-3.50,-3.72,-3.94,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  420
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  430
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  440
     $-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00/      C3D  450
C     DATA(C3(I),I= 381, 540)/                                          C3D  :460
      DATA C3C/                                                         C3D  :461
     1-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  470
     2-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  480
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     3-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,      C3D  490
     4-5.00,-5.00,-5.00,-4.16,-3.97,-3.77,-3.58,-3.38,-3.07,-2.75,      C3D  500
     5-2.44,-2.12,-1.85,-1.57,-1.30,-1.07, -.98, -.94, -.89, -.85,      C3D  510
     6 -.81, -.77, -.72, -.68, -.63, -.58, -.53, -.48, -.41, -.34,      C3D  520
     7 -.26, -.19, -.17, -.18, -.19, -.46, -.79,-1.12,-1.45,-1.75,      C3D  530
     8-2.38,-2.97,-3.57,-4.16,-5.00,-5.00,-5.00,-4.16,-3.90,-3.63,      C3D  540
     9-3.37,-3.10,-2.79,-2.47,-2.15,-1.84,-1.73,-1.63,-1.52,-1.41,      C3D  550
     $-1.33,-1.25,-1.17,-1.09,-1.02, -.96, -.89, -.82, -.73, -.68,      C3D  560
     $ -.54, -.42, -.27, -.12,  .03,  .18,  .25,  .31,  .39,  .47,      C3D  570
     $  .48,  .49,  .50,  .50,  .48,  .46,  .23,  .01, -.11, -.33,      C3D  580
     $ -.55, -.77, -.83, -.88, -.94, -.92, -.91, -.90, -.85, -.80,      C3D  590
     $ -.76, -.71, -.69, -.67, -.66, -.65, -.65, -.66, -.67, -.68,      C3D  600
     $ -.70, -.72, -.82, -.93,-1.03,-1.14,-1.24,-1.34,-1.51,-1.68,      C3D  610
     $-2.13,-2.57,-2.92,-3.26,-3.71,-4.16,-5.00,-5.00,-5.00,-5.00/      C3D  620
      C3L=C3(L)                                                         C3D  630
      RETURN                                                            C3D  640
      END                                                               C3D  650
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      SUBROUTINE EWIDTH(XSTAR,ACBAR,ADBAR,ODBAR,DV,WSL,TTRANS)          EWI   10
C                                                                       EWI   20
C     THIS SUBROUTINE CALCULATES THE EQUIVALENT WIDTH OF A              EWI   30
C     VOIGT LINE IN A FINITE SPECTRAL INTERVAL                          EWI   40
C                                                                       EWI   50
      DATA IENTER,ISTEP,NALF,XSMIN,XSMAX,CDRAT /0,2,3,1.0,50.0,0.1/     EWI   60
      DATA RTPI,C1,C2,RT2 /1.7724539,0.8325546,0.4697186,1.4142136/     EWI   70
C                                                                       EWI   80
C     RTPI = SQRT(PI)                                                   EWI   90
C     C1 = SQRT(ALOG(2.))                                               EWI  100
C     C2 = SQRT(ALOG(2.)/PI)                                            EWI  110
C     RT2 = SQRT(2.)                                                    EWI  120
C                                                                       EWI  130
      IF(IENTER.GT.0) GO TO 1                                           EWI  140
      HALFDV = DV/2.                                                    EWI  150
      NMAX = ISTEP*NALF                                                 EWI  160
      IENTER = 1                                                        EWI  170
    1 CONTINUE                                                          EWI  180
C                                                                       EWI  190
C     FIND LARGER LINEWIDTH, COLLISION(ALFC) OR DOPPLER(ALFD)           EWI  200
C                                                                       EWI  210
      ALFC = ACBAR/ODBAR                                                EWI  220
      ALFD = ADBAR/ODBAR                                                EWI  230
      RAT = ALFC/ALFD                                                   EWI  240
      ALFMAX = ALFC                                                     EWI  250
      IF(RAT.LT.1.0) ALFMAX = ALFD                                      EWI  260
C                                                                       EWI  270
C     CHECK FOR WEAK LINE LIMIT                                         EWI  280
C                                                                       EWI  290
      XS = XSTAR/(ALFMAX*ODBAR)                                         EWI  300
      IF(XS.LT.XSMIN) GO TO 30                                          EWI  310
C                                                                       EWI  320
C     DEFINE INTEGRATION PARAMETERS                                     EWI  330
C                                                                       EWI  340
      DELW = ALFMAX/ISTEP                                               EWI  350
      C3 = XSTAR*C2/ADBAR                                               EWI  360
      C4 = C1/ALFD                                                      EWI  370
      Y = C1*RAT                                                        EWI  380
      DELX = 0.5*DELW*C4                                                EWI  390
      XMIN = NMAX*DELW*C4                                               EWI  400
      SUM = 0.0                                                         EWI  410
C                                                                       EWI  420
C     CHECK FOR DOPPLER LIMIT                                           EWI  430
C                                                                       EWI  440
      IF(RAT.LT.CDRAT) GO TO 20                                         EWI  450
C                                                                       EWI  460
C     CHECK FOR STRONG LINE LIMIT                                       EWI  470
C                                                                       EWI  480
      IF(XS.GT.XSMAX) GO TO 20                                          EWI  490
C                                                                       EWI  500
C     EVALUATE VOIGT LINESHAPE                                          EWI  510
C                                                                       EWI  520
      X = XMIN + DELX                                                   EWI  530
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      DO 10 I = 1,NMAX                                                  EWI  540
      X = X - 2.*DELX                                                   EWI  550
      CALL CPF12(X,Y,WR,WI,WR1)                                         EWI  560
C                                                                       EWI  570
C     INTEGRATE                                                         EWI  580
C                                                                       EWI  590
      FAC = C3*WR                                                       EWI  600
      IF (FAC.GT.6.0) GO TO 20                                          EWI  610
      EXP0 = EXP(-FAC)                                                  EWI  620
      FAC = C3*WR1                                                      EWI  630
      EXP1 = EXP(FAC*DELX)                                              EWI  640
      SUM = SUM + EXP0*(EXP1 - 1./EXP1)/FAC                             EWI  650
   10 CONTINUE                                                          EWI  660
C                                                                       EWI  670
C     CALCULATE ASYMPTOTIC CONTRIBUTION TO EQUIVALENT WIDTH             EWI  680
C                                                                       EWI  690
   20 FAC = SQRT(Y*C3/RTPI)                                             EWI  700
      U1 = FAC/XMIN                                                     EWI  710
      U2 = FAC/(C4*HALFDV)                                              EWI  720
      ASYMP = 0.0                                                       EWI  730
      IF(U2.LT.4.0) ASYMP = EXP(-U2*U2)/U2                              EWI  740
      IF(U1.LT.4.0) ASYMP = ASYMP-EXP(-U1*U1)/U1                        EWI  750
      ASYMP = ASYMP+RTPI*(ERFU(U2)-ERFU(U1))                            EWI  760
      ASYMP = ASYMP*FAC                                                 EWI  770
C                                                                       EWI  780
C     WSL = EQUIVALENT WIDTH OF A SINGLE LINE (CM-1)                    EWI  790
C                                                                       EWI  800
      WSL = DV - 2.0*(SUM+ASYMP)/C4                                     EWI  810
      IF(RAT.LT.CDRAT) GO TO 40                                         EWI  820
      IF(WSL.LT.0.0) WSL = 0.0                                          EWI  830
      IF(WSL.GT.DV) WSL = DV                                            EWI  840
      RETURN                                                            EWI  850
C                                                                       EWI  860
C     BEERS LAW FOR WEAK LINE LIMIT                                     EWI  870
C                                                                       EWI  880
   30 TTRANS = EXP(-XSTAR)                                              EWI  890
      RETURN                                                            EWI  900
C                                                                       EWI  910
C     DOPPLER LIMIT                                                     EWI  920
C                                                                       EWI  930
   40 C3 = XSTAR*C1/(ADBAR*RT2)                                         EWI  940
      WSL = RT2*ALFD*SQRT(ALOG(1.+C3*C3))/C1 + WSL                      EWI  950
      RETURN                                                            EWI  960
      END                                                               EWI  970
```

```
      SUBROUTINE CPF12(X,Y,WR,WI,WR1)                                   CPF   10
C                                                                       CPF   20
C     ROUTINE COMPUTES THE REAL (WR) AND IMAGINARY (WI) PARTS OF THE    CPF   30
C     COMPLEX PROBABILITY FUNCTION W(Z)=EXP(-Z**2)*ERFC(-I*Z) IN THE    CPF   40
C     UPPER HALF-PLANE Z=X+I*Y  (I.E. FOR Y>=0)                         CPF   50
C     MAXIMUM RELATIVE ERROR OF WR IS <2.0E-06, THAT OF WI <5.0E-06     CPF   60
C     THIS ROUTINE DEVELOPED BY J.HUMLICEK, REF. JQSRT,VOL21,P309(1980) CPF   70
C                                                                       CPF   80
      DIMENSION T(6),C(6),S(6)                                          CPF   90
      DATA T/.314240376,.947788391,1.59768264,                          CPF  100
     1      2.27950708,3.02063703,3.8897249/,                           CPF  110
     2     C/1.01172805,-.75197147,1.2557727E-2,                        CPF  120
     3       1.00220082E-2,-2.42068135E-4,5.00848061E-7/,               CPF  130
     4     S/1.393237,.231152406,-.155351466,                           CPF  140
     5       6.21836624E-3,9.19082986E-5,-6.27525958E-7/                CPF  150
      WR = 0.                                                           CPF  160
      WI = 0.                                                           CPF  170
      Y1 = Y + 1.5                                                      CPF  180
      Y2 = Y1*Y1                                                        CPF  190
C     IF HIGH RELATIVE ACCURACY IN REGION II IS NOT REQUIRED, THE       CPF  200
C     FOLLOWING 20 LINES MAY BE DELETED.                                CPF  210
C     IF ((Y.GT.0.85) .OR. (ABS(X).LT.18.1*Y+1.65)) GO TO 2             CPF  220
C****REGION II                                                          CPF  230
C     IF (ABS(X).LT.12.) WR = EXP(-X*X)                                 CPF  240
C     Y3 = Y + 3.                                                       CPF  250
C     DO 1 I = 1,6                                                      CPF  260
C     R = X-T(I)                                                        CPF  270
C     R2 = R*R                                                          CPF  280
C     D = 1./(R2+Y2)                                                    CPF  290
C     D1 = Y1*D                                                         CPF  300
C     D2 = R*D                                                          CPF  310
C     WR = WR + Y*(C(I)*(R*D2-1.5*D1)+S(I)*Y3*D2)/(R2+2.25)             CPF  320
C     R = X+T(I)                                                        CPF  330
C     R2 = R*R                                                          CPF  340
C     D = 1./(R2+Y2)                                                    CPF  350
C     D3 = Y1*D                                                         CPF  360
C     D4 = R*D                                                          CPF  370
C     WR = WR + Y*(C(I)*(R*D4-1.5*D3)-S(I)*Y3*D4)/(R2+2.25)             CPF  380
C   1 WI = WI + C(I)*(D2+D4) + S(I)*(D1-D3)                             CPF  390
C     GO TO 4                                                           CPF  400
C****REGION I                                                           CPF  410
    2 DO 3 I = 1,6                                                      CPF  420
      R = X-T(I)                                                        CPF  430
      D = 1./(R*R+Y2)                                                   CPF  440
      D1 = Y1*D                                                         CPF  450
      D2 = R*D                                                          CPF  460
      R = X+T(I)                                                        CPF  470
      D = 1./(R*R+Y2)                                                   CPF  480
      D3 = Y1*D                                                         CPF  490
      D4 = R*D                                                          CPF  500
      WR = WR + C(I)*(D1+D3) - S(I)*(D2-D4)                             CPF  510
    3 WI = WI + C(I)*(D2+D4) + S(I)*(D1-D3)                             CPF  520
C****CALCULATE FIRST DERIVATIVE OF W(Z) FOR VOIGT PROFILE               CPF  530
```

```
4 CONTINUE                                                    CPF  540
  WR1 = 2.*(Y*WI-X*WR)                                        CPF  550
  RETURN                                                      CPF  560
  END                                                         CPF  570
```

```
      SUBROUTINE LIB(MSLTO,LPLT)                                        LIB   10
C                                                                       LIB   20
C                                                                       LIB   30
C      LIB CALLS THE SLIT FUNCTION ROUTINE, SETS                        LIB   40
C        UP THE OUTPUT AND THEN PLOTS                                   LIB   50
C                                                                       LIB   60
C                                                                       LIB   70
C*******************************                                        LIB   80
C**** IMPLEMENTATION NOTE ****                                          LIB   90
C*******************************                                        LIB  100
C     1) TITLE ASSIGNMENTS WILL HAVE TO BE CHANGED FOR MACHINES THAT    LIB  110
C          STORE MORE THAN 4 CHARACTERS PER WORD (UNIVAC + CDC)         LIB  120
C         VARIABLES EFFECTED:  XTIT, YTIT, BLANK, TITLE, NCWD           LIB  130
C         FORMAT STATEMENTS :  900, 902                                 LIB  140
C     2) PLOTTER INITIALIZATION MAY HAVE TO BE CHANGED                  LIB  150
C         CALLS EFFECTED:  INITP$                                       LIB  160
C     3) PLOTTER TERMINATION MAY NEED CHANGING                          LIB  170
C         CALLS EFFECTED:  ENDPLT                                       LIB  180
C     4) FOR THE PRIME: COMPILE WITH SHORT INTEGER AND INCLUDE THE      LIB  190
C          INTEGER*4 STATMENT                                           LIB  200
C                                                                       LIB  210
C                                                                       LIB  220
C     INTEGER*4 NIN,NOUT,NSTOR,NPLT,NTBL,IXY,MSLTO,LPLT                 LIB  230
      COMMON/CARD4/ IXY                                                 LIB  240
      LOGICAL PLTR,PRTR                                                 LIB  250
      DIMENSION XTIT(5,2),YTIT(7,3)                                     LIB  260
      DIMENSION XTITLE(20),YTITLE(20),TITLE(20),IXT(2),IYT(3)           LIB  270
      DIMENSION XSS(8),SS(8)                                            LIB  280
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          LIB  290
      COMMON /PLTDEV/ NSCR,NPLTR                                        LIB  300
      COMMON/XBLOCK/XTITLE,XAXIS,XINIT,XSCALE,DXT,NMINX                 LIB  310
      COMMON/YBLOCK/YTITLE,YAXIS,YINIT,YSCALE,DYT,NMINY                 LIB  320
      COMMON/MAXY/YMAX                                                  LIB  330
      COMMON/PBLOCK/TITLE,ICHAR,JCHAR,KCHAR                             LIB  340
      COMMON/SETUP/ITYPE,ISLOT,NEWT,IPRT                                LIB  350
      DATA XTIT/4HWAVE,4HLENG,4HTH  ,4H(MIC,4HRON),                     LIB  360
     *          4HWAVE,4HNUMB,4HER  ,4H(CM-,4H1)  /                    LIB  370
      DATA YTIT/4HTRAN,4HSMIT,4HTANC,4HE   ,4H    ,4H    ,4H    ,      LIB  380
     *          4HRADI,4HANCE,4H  (W,4H/SR/,4HCM2/,4HMICR,4HON) ,      LIB  390
     *          4HRADI,4HANCE,4H  (W,4H/SR/,4HCM2/,4HCM-1,4H)   /      LIB  400
      DATA IYT/13,27,25/,IXT/20,18/                                     LIB  410
C                                                                       LIB  420
      DATA XORG,YORG/1.,1./,BLANK/4H    /,NCWD/4/                       LIB  430
C     SET PLOT DEVICE NUMBERS                                           LIB  440
      NSCR = 11                                                         LIB  450
      NPLTR = 4                                                         LIB  460
C                                                                       LIB  470
      PRTR=.FALSE.                                                      LIB  480
      PLTR=.FALSE.                                                      LIB  490
      READ(NIN,900) TITLE                                               LIB  500
      DO 10 I=1,20                                                      LIB  510
      KCHAR=21-I                                                        LIB  520
      IF(TITLE(KCHAR).NE.BLANK) GO TO 15                                LIB  530
```

```
   10 CONTINUE                                                          LIB  540
   15 KCHAR=KCHAR*NCWD                                                  LIB  550
      READ(NIN,904) MSLT,MPRTN,MPLTN,NSN,WIDTHN,SHIFTN                  LIB  560
      IF(MSLT .EQ. 0 .AND. MSLTO .EQ. 0) STOP 3                         LIB  570
      IF(MSLT .EQ. 0) GO TO 20                                          LIB  580
      MPRT=MPRTN                                                        LIB  590
      MPLT=MPLTN                                                        LIB  600
      NS=NSN                                                            LIB  610
      WIDTH=WIDTHN                                                      LIB  620
      SHIFT=SHIFTN                                                      LIB  630
      JSLOT=MSLT                                                        LIB  640
C                                                                       LIB  650
C     SET UP FOR TRANSMISSION AND RADIANCE OUTPUT                       LIB  660
C                                                                       LIB  670
   20 DO 75 ITYPE=1,2                                                   LIB  680
      ITY=3-ITYPE                                                       LIB  690
      REWIND NPLT                                                       LIB  700
      REWIND NSCR                                                       LIB  710
      YMAX=0.                                                           LIB  720
      IPRT=1                                                            LIB  730
      IF(IABS(MPRT).EQ.ITY .OR. MPRT.EQ.0) IPRT=-1                      LIB  740
      IF(IPRT .GT. 0) WRITE(NOUT,902) TITLE                             LIB  750
C                                                                       LIB  760
C     READ IN SLIT FUNCTION INFO                                        LIB  770
C                                                                       LIB  780
      IF(MSLT .EQ. 0) GO TO 35                                          LIB  790
      IF(PRTR) GO TO 30                                                 LIB  800
      IF (JSLOT.EQ.1) GO TO 30                                          LIB  810
      READ(NIN,906) (XSS(I),I=1,NS)                                     LIB  820
      READ(NIN,906) (SS(I),I=1,NS)                                      LIB  830
   30 PRTR=.TRUE.                                                       LIB  840
C                                                                       LIB  850
C     GET PLOT INFO                                                     LIB  860
C                                                                       LIB  870
      IF (LPLT.NE.0 .OR. MPLT.EQ.0) GO TO 35                            LIB  880
      LPLT = 1                                                          LIB  890
C     OPEN PLOTTER ON FIRST CALL                                        LIB  900
      CALL INITP$(NPLTR,0)                                              LIB  910
      CALL PLOT (XORG,YORG,-3)                                          LIB  920
   35 ISLOT=1                                                           LIB  930
      IF(IABS(MPLT).EQ.ITY .OR. MPLT.EQ.0) ISLOT=-1                     LIB  940
      IF(IPRT.LT.0 .AND. ISLOT.LT.0) GO TO 75                           LIB  950
      NEWT=1                                                            LIB  960
      IF(MPLT .LT. 0) NEWT=-1                                           LIB  970
      IF(ISLOT.LT.0) GO TO 55                                           LIB  980
      IF(PLTR .OR. MSLT.EQ.0) GO TO 40                                  LIB  990
      READ(NIN,908) XAXIS,XINIT,XEND,DXT,NMINX                          LIB 1000
      READ(NIN,908) YAXIS,YINI,YEND,DY,NMINY                            LIB 1010
      PLTR=.TRUE.                                                       LIB 1020
   40 IB=(NEWT+1)/2 + 1                                                 LIB 1030
      XSCALE=(XEND-XINIT)/XAXIS                                         LIB 1040
      YINIT=YINI                                                        LIB 1050
      YSCALE=(YEND-YINIT)/YAXIS                                         LIB 1060
```

```
      DYT=DY                                                          LIB 1070
      DO 45 I=1,5                                                     LIB 1080
   45 XTITLE(I)=XTIT(I,IX)                                            LIB 1090
      ICHAR=IXT(IX)                                                   LIB 1100
      IX=IX+1                                                         LIB 1110
      IF(ITYPE .EQ. 1) IX=1                                           LIB 1120
      DO 50 I=1,7                                                     LIB 1130
   50 YTITLE(I)=YTIT(I,IX)                                            LIB 1140
      JCHAR=IYT(IX)                                                   LIB 1150
C                                                                     LIB 1160
C    CALCULATE AND OUTPUT                                             LIB 1170
C                                                                     LIB 1180
   55 IF (JSLOT.EQ.1) GO TO 65                                        LIB 1190
      WRITE(NOUT,910) WIDTH,SHIFT,NS                                  LIB 1200
      WRITE(NOUT,912) (SS(I),I=1,NS)                                  LIB 1210
      WRITE(NOUT,914) (XSS(I),I=1,NS)                                 LIB 1220
      CALL GEN(WIDTH,SHIFT,XSS,SS,NS)                                 LIB 1230
      GO TO 70                                                        LIB 1240
   65 WRITE(NOUT,916)                                                 LIB 1250
      CALL ALL                                                        LIB 1260
   70 CONTINUE                                                        LIB 1270
      IF(ISLOT.GT.0) CALL PLOT(XAXIS+5.0,0.0,-3)                      LIB 1280
   75 CONTINUE                                                        LIB 1290
      MSLTO=JSLOT                                                     LIB 1300
C     REWIND NPLT IN CASE THERE IS ANOTHER CALCULATION                LIB 1310
      REWIND NPLT                                                     LIB 1320
C     CLOSE PLOTTER ON LAST CALCULATION                               LIB 1330
      IF (IXY.EQ.0 .AND. LPLT.EQ.1) CALL ENDPLT                       LIB 1340
      RETURN                                                          LIB 1350
C                                                                     LIB 1360
  900 FORMAT(20A4)                                                    LIB 1370
  902 FORMAT(1H1,30X,20A4)                                            LIB 1380
  904 FORMAT(4I2,2X,2F10.0)                                           LIB 1390
  906 FORMAT(8F10.5)                                                  LIB 1400
  908 FORMAT(4E10.4,I10)                                              LIB 1410
  910 FORMAT(//1X,22HVARIABLE SLIT FUNCTION/1X,6HWIDTH=,F10.5,4X,     LIB 1420
     1 6HSHIFT=,F10.5,4X,20HNO. OF DEFINING PTS=,I2)                  LIB 1430
  912 FORMAT(1X,8HYS ARE  ,8F10.3)                                    LIB 1440
  914 FORMAT(1X,8HXS ARE  ,8F10.3)                                    LIB 1450
  916 FORMAT(//1X,25HNO SLIT FUNCTION USED             ///)           LIB 1460
      END                                                             LIB 1470
```

```
      SUBROUTINE ALL                                                    ALL  10
C                                                                       ALL  20
C                                                                       ALL  30
C      PRINTS/PLOTS UNDEGRADED SPECTRUM                                 ALL  40
C                                                                       ALL  50
C                                                                       ALL  60
C*******************************                                        ALL  70
C**** IMPLEMENTATION NOTE ****                                          ALL  80
C*******************************                                        ALL  90
C     FOR THE PRIME: COMPILE WITH SHORT INTEGER AND INCLUDE THE         ALL 100
C           INTEGER*4 STATMENT                                          ALL 110
C                                                                       ALL 120
C                                                                       ALL 130
C     INTEGER*4 NIN,NOUT,NSTOR,NPLT,NTBL                               ALL 140
      DOUBLE PRECISION DVM,XFF                                          ALL 150
      DIMENSION Y(363),X(363),V(2)                                      ALL 160
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          ALL 170
      COMMON/BLOCK2/Y,X                                                 ALL 180
      COMMON/VS/ VS1,VS2                                                ALL 190
      COMMON/SETUP/ITYPE,ISLOT,NEWT,IPRT                                ALL 200
      READ(NPLT) VS1,VS2,DV                                             ALL 210
      DVM=DV                                                            ALL 220
      XFF = VS1 - DVM                                                   ALL 230
      N = 0                                                             ALL 240
   10 READ(NPLT) V(2),V(1)                                              ALL 250
      IF (V(1).EQ.-1. .AND. V(2).EQ.-1.) GO TO 20                       ALL 260
      XFF = XFF + DVM                                                   ALL 270
      N = N + 1                                                         ALL 280
      X(N) = XFF                                                        ALL 290
      Y(N) = V(ITYPE)                                                   ALL 300
      IF (N.EQ.360) CALL WRTDAT(N,X,Y)                                  ALL 310
      GO TO 10                                                          ALL 320
   20 IF (N.NE.0) CALL WRTDAT(N,X,Y)                                    ALL 330
      CALL WRTDAT(N,X,Y)                                                ALL 340
      CALL PROUT                                                        ALL 350
      RETURN                                                            ALL 360
      END                                                               ALL 370
```

```
      SUBROUTINE GEN(WIDTH,SHIFT,XSS,SS,NS)                                GEN   10
C                                                                          GEN   20
C                                                                          GEN   30
C      SLIT FUNCTION                                                       GEN   40
C                                                                          GEN   50
C                                                                          GEN   60
C*****************************                                           GEN   70
C**** IMPLEMENTATION NOTE ****                                           GEN   80
C*****************************                                           GEN   90
C     FOR THE PRIME: COMPILE WITH SHORT INTEGER AND INCLUDE THE            GEN  100
C          INTEGER*4 STATMENT                                              GEN  110
C                                                                          GEN  120
C     INTEGER*4 NIN,NOUT,NSTOR,NPLT,NTBL                                   GEN  130
      DOUBLE PRECISION DVM,XMID,XFF                                        GEN  140
      LOGICAL FIRST                                                        GEN  150
      DIMENSION ARRAY(360),F(360),Y(363),X(363)                            GEN  160
      DIMENSION XS(8),S(8),XSS(1),SS(1),XC(8),V(2)                         GEN  170
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                             GEN  180
      COMMON/BLOCK1/F                                                      GEN  190
      COMMON/BLOCK2/Y,X                                                    GEN  200
      COMMON/BLOCK3/ARRAY                                                  GEN  210
      COMMON/VS/ VS1,VS2                                                   GEN  220
      COMMON/SETUP/ITYPE,ISLOT,NEWT,IPRT                                   GEN  230
C                                                                          GEN  240
C     NDEG = ORDER OF THE INTERPOLATION --- NS MUST BE AT LEAST NDEG+1     GEN  250
C                                                                          GEN  260
      DATA NDEG/1/                                                         GEN  270
C                                                                          GEN  280
      FIRST=.TRUE.                                                         GEN  290
      N=0                                                                  GEN  300
      READ(NPLT) VS1,VS2,DV                                                GEN  310
      DVM=DV                                                               GEN  320
      XFF = VS1 - DVM                                                      GEN  330
C                                                                          GEN  340
C     NORMALIZE SLIT FUNCTION                                              GEN  350
C                                                                          GEN  360
      IF(WIDTH .GE. 1800.) GO TO 96                                        GEN  370
      IF(DVM .GE. WIDTH) GO TO 95                                          GEN  380
      FAC=WIDTH/(XSS(NS)-XSS(1))                                           GEN  390
      DO 20 IS=1,NS                                                        GEN  400
      XS(IS)=FAC*(XSS(IS)-XSS(1)) - .5*WIDTH                               GEN  410
      S(IS)=SS(IS)                                                         GEN  420
   20 CONTINUE                                                             GEN  430
      IF(DVM .GT. .3333*WIDTH) WRITE(NOUT,902)                             GEN  440
      XMID=XF - DVM                                                        GEN  450
C                                                                          GEN  460
   25 NF = 0                                                               GEN  470
   30 READ(NPLT) V(2),V(1)                                                 GEN  480
      IF (V(1).EQ.-1. .AND. V(2).EQ.-1.) GO TO 50                          GEN  490
      XFF = XFF + DVM                                                      GEN  500
      IF (NF.EQ.0) XF = XFF                                                GEN  510
      NF = NF + 1                                                          GEN  520
      F(NF) = V(ITYPE)                                                     GEN  530
```

```
      IF (NF.NE.360) GO TO 30                                          GEN  540
C                                                                      GEN  550
C     CALCULATE SLIT FUNCTION                                          GEN  560
C                                                                      GEN  570
   50 IF(NF .EQ. 0) GO TO 90                                           GEN  580
      XMID=XMID + SHIFT                                                GEN  590
      DO 55 I=1,NS                                                     GEN  600
   55 XC(I)=XS(I) + XMID                                               GEN  610
      SUM=0.                                                           GEN  620
      AREA=0.                                                          GEN  630
      IXX=(XC(1)-XF)/DVM                                               GEN  640
      IF(IXX.LT.0 .AND. FIRST) GO TO 50                                GEN  650
      XX=FLOAT(IXX-1)*DVM + XF                                         GEN  660
      IX=IXX                                                           GEN  670
   60 XX=XX+DVM                                                        GEN  680
      IX=IX+1                                                          GEN  690
      IF(XX .GT. XC(NS)) GO TO 75                                      GEN  700
      IF(IX .GT. NF) GO TO 80                                          GEN  710
      TERPV=TERP(XX,XC,S,NDEG,NS,IER)                                  GEN  720
      AREA=AREA + TERPV                                                GEN  730
      IF(IX .GE. 1) GO TO 70                                           GEN  740
C     GET DATA FROM BEFORE CURRENT DATA BLOCK                          GEN  750
      J=IABS(IX) + 1                                                   GEN  760
      SUM=SUM + TERPV*ARRAY(J)                                         GEN  770
      GO TO 60                                                         GEN  780
C                                                                      GEN  790
   70 SUM=SUM + TERPV*F(IX)                                            GEN  800
      GO TO 60                                                         GEN  810
   75 N=N + 1                                                          GEN  820
      X(N)=XMID                                                        GEN  830
      Y(N)=SUM/AREA                                                    GEN  840
      IF(N .EQ. 360) CALL WRTDAT(N,X,Y)                                GEN  850
      GO TO 50                                                         GEN  860
C                                                                      GEN  870
C     STORE THE END OF THIS INFO BEFORE READING IN THE NEXT BLOCK      GEN  880
C                                                                      GEN  890
   80 IF (NF.NE.360) GO TO 90                                          GEN  900
      DO 85 I=IXX,NF                                                   GEN  910
      IX=NF-I+1                                                        GEN  920
      ARRAY(IX)=F(I)                                                   GEN  930
   85 CONTINUE                                                         GEN  940
      XMID=XMID-SHIFT                                                  GEN  950
      FIRST = .FALSE.                                                  GEN  960
      GO TO 25                                                         GEN  970
C                                                                      GEN  980
   90 IF (N.NE.0) CALL WRTDAT(N,X,Y)                                   GEN  990
      CALL WRTDAT(N,X,Y)                                               GEN 1000
      CALL PROUT                                                       GEN 1010
      RETURN                                                           GEN 1020
C                                                                      GEN 1030
   95 WRITE(NOUT,904)                                                  GEN 1040
      STOP 2                                                           GEN 1050
   96 WRITE(NOUT,905)                                                  GEN 1060
```

```
      STOP 7                                                          GEN 1070
  902 FORMAT(38H0**WARNING**  WIDTH IS LESS THAN 3.*DV)               GEN 1080
  904 FORMAT(33H0**ERROR**  WIDTH SMALLER THAN DV)                    GEN 1090
  905 FORMAT(35H0**ERROR**  WIDTH GREATER THAN 1800)                  GEN 1100
      END                                                             GEN 1110
```

```
      SUBROUTINE PROUT                                                  PRO   10
C                                                                       PRO   20
C                                                                       PRO   30
C     PRINT OUTPUT AND PLOT CURVES                                      PRO   40
C                                                                       PRO   50
C                                                                       PRO   60
C*******************************                                        PRO   70
C**** IMPLEMENTATION NOTE ****                                          PRO   80
C*******************************                                        PRO   90
C     1) TITLE ASSIGNMENTS WILL HAVE TO BE CHANGED FOR MACHINES THAT    PRO  100
C          STORE MORE THAN 4 CHARACTERS PER WORD (UNIVAC + CDC)         PRO  110
C         VARIABLES EFFECTED:  TNORM1, TNORM2                           PRO  120
C     2) FOR THE PRIME: COMPILE WITH SHORT INTEGER AND INCLUDE THE      PRO  130
C          INTEGER*4 STATMENT                                           PRO  140
C                                                                       PRO  150
C                                                                       PRO  160
C     INTEGER*4 NIN,NOUT,NSTOR,NPLT,NTBL                                PRO  170
      LOGICAL FIRST                                                     PRO  180
      DIMENSION XTITLE(20),YTITLE(20),TITLE(20),TNORM1(5)               PRO  190
      DIMENSION Y(360),X(360),XX(363),YY(363),OUT(4,3)                  PRO  200
      COMMON /DEVNUM/ NIN,NOUT,NSTOR,NPLT,NTBL                          PRO  210
      COMMON /PLTDEV/ NSCR,NPLTR                                        PRO  220
      COMMON/BLOCK1/X                                                   PRO  230
      COMMON/BLOCK2/YY,XX                                               PRO  240
      COMMON/BLOCK3/Y                                                   PRO  250
      COMMON/XBLOCK/XTITLE,XAXIS,XINIT,XSCALE,DXT,NMINX                 PRO  260
      COMMON/YBLOCK/YTITLE,YAXIS,YINIT,YSCALE,DYT,NMINY                 PRO  270
      COMMON/MAXY/YMAX                                                  PRO  280
      COMMON/PBLOCK/TITLE,ICHAR,JCHAR,KCHAR                             PRO  290
      COMMON/VS/ VS1,VS2                                                PRO  300
      COMMON/SETUP/ITYPE,ISLOT,NEWT,IPRT                                PRO  310
      DATA TNORM1/4H  NO,4HRMAL,4HIZED,4H TO ,4H10.(/                   PRO  320
      DATA TNORM2/4H)   /                                               PRO  330
C                                                                       PRO  340
      FIRST=.TRUE.                                                      PRO  350
      IF(ISLOT .LT. 0) GO TO 40                                         PRO  360
C                                                                       PRO  370
C     SET UP FOR PLOTTING                                               PRO  380
C                                                                       PRO  390
      IF(NEWT .GT. 0) GO TO 30                                          PRO  400
      VSX=VS1                                                           PRO  410
      VS1=1.E+4/VS2                                                     PRO  420
      VS2=1.E+4/VSX                                                     PRO  430
C     SET APPROPRIATE MAXIMA FOR AXIS                                   PRO  440
   30 IF(XINIT .LE. 0.) XINIT=VS1                                       PRO  450
      IF(XSCALE .LE. 0.) XSCALE=(VS2-XINIT)/XAXIS                       PRO  460
      IF(DXT .LE. 0.) DXT=XSCALE                                        PRO  470
      IF(NMINX .LE. 0) NMINX=9                                          PRO  480
      IF(YSCALE .GT. 0) GO TO 35                                        PRO  490
      IEXP=ALOG10(YMAX)                                                 PRO  500
      IF(YMAX .LT. 1.) IEXP=IEXP-1                                      PRO  510
      IF(IEXP .EQ. -1) IEXP=0                                           PRO  520
      YMAX=INT(YMAX/10.**IEXP + .99)                                    PRO  530
```

```
      YINIT=YINIT/10.**IEXP                                                PRO  540
      YSCALE=(YMAX-YINIT)/YAXIS                                            PRO  550
      NMINY=9                                                              PRO  560
      DYT=YSCALE                                                           PRO  570
      GO TO 45                                                             PRO  580
   35 YCHECK=YINIT+YAXIS*YSCALE                                            PRO  590
      IF(YMAX.LE.YCHECK) IEXP=INT(ALOG10(YCHECK))-1                        PRO  600
      IF(YMAX.GT.YCHECK) IEXP=INT(ALOG10(YMAX))-1                          PRO  610
      IF(IEXP.EQ.-1) IEXP=0                                                PRO  620
      YINIT=YINIT/10.**IEXP                                                PRO  630
      IF(YMAX.GT.YCHECK) YMAX=INT(YMAX/10.**IEXP+.99)                      PRO  640
      IF(YMAX.GT.YCHECK) YSCALE=(YMAX-YINIT)/YAXIS                         PRO  650
      IF(YMAX.LE.YCHECK) YSCALE=YSCALE/10.**IEXP                           PRO  660
      IF(YMAX.GT.YCHECK) DYT=YSCALE                                        PRO  670
      IF(YMAX.LE.YCHECK) DYT=DYT/10.**IEXP                                 PRO  680
   45 XEND=XSCALE*XAXIS*1.01 + XINIT                                       PRO  690
C                                                                          PRO  700
C     PLOT AXES AND ANNOTATION                                             PRO  710
C                                                                          PRO  720
      CALL AXIS(0.0,0.0,XTITLE,-ICHAR,XAXIS,0.0,XINIT,XSCALE,DXT,NMINX)    PRO  730
      CALL AXIS(0.0,YAXIS,TITLE,+KCHAR,XAXIS,0.0,XINIT,XSCALE,DXT,NMINX)   PRO  740
      CALL AXIS(0.0,0.0,YTITLE,+JCHAR,YAXIS,90.0,YINIT,YSCALE,DYT,NMINY)   PRO  750
      CALL AXIS(XAXIS,0.0,4H     ,-4,YAXIS,90.0,YINIT,YSCALE,DYT,NMINY)    PRO  760
      IF(IEXP.EQ.0) GO TO 40                                               PRO  770
      CALL SYMBOL(XAXIS+1.,3.*YAXIS/40.,YAXIS/40.,TNORM1,90.0,20)          PRO  780
      CALL WHERE(XNORM,YNORM,DUMFAC)                                       PRO  790
      TEXP=IEXP                                                            PRO  800
      CALL NUMBER(XNORM,YNORM,YAXIS/40.,TEXP,90.0,-1)                      PRO  810
      CALL WHERE(XNORM,YNORM,DUMFAC)                                       PRO  820
      CALL SYMBOL(XNORM,YNORM,YAXIS/40.,TNORM2,90.0,4)                     PRO  830
C                                                                          PRO  840
   40 N1=0                                                                 PRO  850
      REWIND NSCR                                                          PRO  860
   10 READ(NSCR) N                                                         PRO  870
      IF(N.EQ.0) RETURN                                                    PRO  880
      READ(NSCR) (X(I),Y(I),I=1,N)                                         PRO  890
      IF(ISLOT.LT.0) GO TO 55                                              PRO  900
      DO 25 I=1,N                                                          PRO  910
      XPT=X(I)                                                             PRO  920
      YPT=Y(I)                                                             PRO  930
      IF(NEWT .GT. 0) GO TO 20                                             PRO  940
      IF(ITYPE .EQ. 1) GO TO 15                                            PRO  950
      YPT=1.E-4*YPT*XPT*XPT                                                PRO  960
   15 XPT=1.E+4/XPT                                                        PRO  970
   20 IF(XPT .GT. XEND) GO TO 26                                           PRO  980
      IF(XPT .LT. XINIT) GO TO 25                                          PRO  990
      N1=N1+1                                                              PRO 1000
      XX(N1)=XPT                                                           PRO 1010
      YY(N1)=YPT                                                           PRO 1020
   25 CONTINUE                                                             PRO 1030
   26 DO 50 I=1,N1                                                         PRO 1040
   50 YY(I)=YY(I)/10.**IEXP                                                PRO 1050
      XX(N1+1)=XINIT                                                       PRO 1060
```

```
      XX(N1+2)=XSCALE                                                    PRO 1070
      YY(N1+1)=YINIT                                                     PRO 1080
      YY(N1+2)=YSCALE                                                    PRO 1090
C                                                                        PRO 1100
C     PLOT LINE                                                          PRO 1110
C                                                                        PRO 1120
      IF(N1 .LE. 1) GO TO 55                                             PRO 1130
      CALL LINE(XX,YY,N1,1,0,0)                                          PRO 1140
      XX(1)=XX(N1)                                                       PRO 1150
      YY(1)=YY(N1)*10.**IEXP                                             PRO 1160
      N1=1                                                               PRO 1170
C                                                                        PRO 1180
C     OUTPUT INFO TO UNIT #NOUT                                          PRO 1190
C                                                                        PRO 1200
   55 IF(IPRT .LT. 0) GO TO 10                                           PRO 1210
      IF(.NOT.FIRST) WRITE(NOUT,901)                                     PRO 1220
      IF(ITYPE.EQ.1.AND.FIRST) WRITE(NOUT,902)                           PRO 1230
      IF(ITYPE.EQ.2.AND.FIRST) WRITE(NOUT,903)                           PRO 1240
      FIRST = .FALSE.                                                    PRO 1250
      DO 90 II=1,N,180                                                   PRO 1260
      NN=II+179                                                          PRO 1270
      IF(NN .GT. N) NN=N                                                 PRO 1280
      NN3=(NN-II+1)/3                                                    PRO 1290
      IF(NN3*3 .NE. NN-II+1) NN3=NN3+1                                   PRO 1300
      NI=II+NN3-1                                                        PRO 1310
      IF(ITYPE.EQ.2) GO TO 60                                            PRO 1320
      WRITE(NOUT,904)                                                    PRO 1330
      WRITE(NOUT,905)                                                    PRO 1340
      GO TO 65                                                           PRO 1350
   60 WRITE(NOUT,906)                                                    PRO 1360
      WRITE(NOUT,907)                                                    PRO 1370
   65 DO 85 I=II,NI                                                      PRO 1380
      DO 75 NCOL=1,3                                                     PRO 1390
      I1=I + (NCOL-1)*NN3                                                PRO 1400
      IF(I1 .GT. NN) GO TO 80                                            PRO 1410
      IF(ITYPE .EQ. 2) GO TO 70                                          PRO 1420
      OUT(2,NCOL)=X(I1)                                                  PRO 1430
      OUT(1,NCOL)=1.E+4/X(I1)                                            PRO 1440
      OUT(3,NCOL)=Y(I1)                                                  PRO 1450
      OUT(4,NCOL)=Y(I1)                                                  PRO 1460
      GO TO 75                                                           PRO 1470
   70 OUT(3,NCOL)=1.E+4/X(I1)                                            PRO 1480
      OUT(4,NCOL)=1.E-4*Y(I1)*X(I1)*X(I1)                                PRO 1490
      OUT(1,NCOL)=X(I1)                                                  PRO 1500
      OUT(2,NCOL)=Y(I1)                                                  PRO 1510
   75 CONTINUE                                                           PRO 1520
      NCOL=4                                                             PRO 1530
   80 NCOL=NCOL - 1                                                      PRO 1540
      IF(ITYPE.EQ.1) WRITE(NOUT,908) ((OUT(J,K),J=1,4),K=1,NCOL)         PRO 1550
      IF(ITYPE.EQ.2) WRITE(NOUT,909) ((OUT(J,K),J=1,4),K=1,NCOL)         PRO 1560
   85 CONTINUE                                                           PRO 1570
   90 CONTINUE                                                           PRO 1580
      GO TO 10                                                           PRO 1590
```

```
901 FORMAT(1H1)                                                          PRO 1600
902 FORMAT(1H1,54X,25HATMOSPHERIC TRANSMITTANCE)                         PRO 1610
903 FORMAT(1H1,51X,32HRADIATION (WATTS/SR/CM**2/UNITS))                  PRO 1620
904 FORMAT(/2(1X,6HLAMBDA,7X,1HV,9X,13HTRANSMITTANCE,10X),               PRO 1630
   1          1X,6HLAMBDA,7X,1HV,9X,13HTRANSMITTANCE)                   PRO 1640
905 FORMAT(2(1X,7HMICRONS,4X,4HCM-1,31X),1X,7HMICRONS,4X,4HCM-1)         PRO 1650
906 FORMAT(/2(4X,1HV,6X,9HRADIATION,4X,6HLAMBDA,2X,9HRADIATION,4X),      PRO 1660
   1          4X,1HV,6X,9HRADIATION,4X,6HLAMBDA,2X,9HRADIATION)         PRO 1670
907 FORMAT(2(3X,4HCM-1,4X,8HPER CM-1,4X,7HMICRONS,3X,6HPER UM,6X),       PRO 1680
   1         3X,4HCM-1,4X,8HPER CM-1,4X,7HMICRONS,3X,6HPER UM)          PRO 1690
908 FORMAT(2(1X,F7.4,3X,F7.2,5X,F4.2,5X,F7.5,8X),                        PRO 1700
   1         1X,F7.4,3X,F7.2,5X,F4.2,5X,F7.5)                           PRO 1710
909 FORMAT(2(1X,0PF7.2,2X,1PE10.4,3X,0PF7.4,2X,1PE9.3,4X),               PRO 1720
   1         1X,0PF7.2,2X,1PE10.4,3X,0PF7.4,2X,1PE9.3)                  PRO 1730
    END                                                                  PRO 1740
```

```
      SUBROUTINE WRTDAT(N,X,Y)                                          WRT   10
C                                                                       WRT   20
C                                                                       WRT   30
C     WRITES INFO ON UNIT #NSCR IN BINARY                               WRT   40
C        SETS UP DATA FOR PROUT                                         WRT   50
C                                                                       WRT   60
C                                                                       WRT   70
C*******************************                                        WRT   80
C**** IMPLEMENTATION NOTE ****                                          WRT   90
C*******************************                                        WRT  100
C     FOR THE PRIME: COMPILE WITH SHORT INTEGER                         WRT  110
C                                                                       WRT  120
C                                                                       WRT  130
      LOGICAL FLAG                                                      WRT  140
      DIMENSION X(1),Y(1)                                               WRT  150
      COMMON /PLTDEV/ NSCR,NPLTR                                        WRT  160
      COMMON/MAXY/YMAX                                                  WRT  170
      COMMON/SETUP/ITYPE,ISLOT,NEWT,IPRT                                WRT  180
C                                                                       WRT  190
      WRITE(NSCR) N                                                     WRT  200
      IF(N .EQ. 0) RETURN                                               WRT  210
      IF(ISLOT .LT.0) GO TO 20                                          WRT  220
      FLAG=NEWT.LT.0 .AND. ITYPE.EQ.2                                   WRT  230
      DO 10 I=1,N                                                       WRT  240
      YI=Y(I)                                                           WRT  250
      IF(FLAG) YI=1.E-04*YI*X(I)**2                                     WRT  260
   10 YMAX=AMAX1(YI,YMAX)                                               WRT  270
   20 WRITE(NSCR) (X(I),Y(I),I=1,N)                                     WRT  280
      N=0                                                               WRT  290
      RETURN                                                            WRT  300
      END                                                               WRT  310
```

```
      FUNCTION TERP(XC,X,Y,NDEG,NPTS,IER)                                TER   10
C                                                                        TER   20
C                                                                        TER   30
C     FUNCTION PERFORMS NEWTONS INTERPOLATION FOR DISCRETE DATA          TER   40
C           AS A FUNCTION OF ONE VARIABLE                                TER   50
C                                                                        TER   60
C     WHERE  XC - INDEPENDENT VARIABLE AT WHICH THE INTERPOLATED         TER   70
C               VALUE OF THE DEPENDENT VARIABLE IS DESIRED               TER   80
C            X - TABLE OF INDEPENDENT VARIABLE VALUES IN INCREASING      TER   90
C                ORDER                                                   TER  100
C            Y - CORRESPONDING TABLE OF DEPENDENT VARIABLE VALUES        TER  110
C         NDEG - ORDER OF THE INTERPOLATING POLYNOMIAL USED (MAX - 10)   TER  120
C         NPTS - NUMBER OF ENTRIES IN X AND Y                            TER  130
C          IER - RETURN CODE:                                            TER  140
C                    0 = INTERPOLATION WAS PERFORMED                     TER  150
C                   -1 = EXTRAPOLATION BELOW TABLE VALUES                TER  160
C                    1 = EXTRAPOLATION ABOVE TABLE VALUES                TER  170
C                                                                        TER  180
C     ROUTINE MODIFIED FROM 'THE COMPUTING TECHNOLOGY CENTER             TER  190
C       NUMERICAL ANALYSIS LIBRARY', O.R.N.L.                            TER  200
C                                                                        TER  210
C                                                                        TER  220
C********************************                                       TER  230
C**** IMPLEMENTATION NOTE ****                                           TER  240
C********************************                                       TER  250
C     FOR THE PRIME: COMPILE WITH SHORT INTEGER                          TER  260
C                                                                        TER  270
C                                                                        TER  280
      DIMENSION X(1),Y(1),Y1(11)                                         TER  290
      INTEGER HI                                                         TER  300
C                                                                        TER  310
      NFIT=NDEG + 1                                                      TER  320
      N=NFIT                                                             TER  330
      IF(N .GT. NPTS) N=NPTS                                             TER  340
      IF(XC-X(1)) 50,20,10                                               TER  350
   10 IF(XC .GT. X(NPTS)) GO TO 70                                       TER  360
   20 IER=0                                                              TER  370
      DO 30 I=1,NPTS                                                     TER  380
      IF(XC - X(I)) 40,120,30                                            TER  390
   30 CONTINUE                                                           TER  400
   40 LOW=I - (N+1)/2                                                    TER  410
      IF(LOW .LE. 0) GO TO 60                                            TER  420
      HI=LOW + N - 1                                                     TER  430
      IF(HI .GT. NPTS) GO TO 80                                          TER  440
      GO TO 90                                                           TER  450
C                                                                        TER  460
C     XC LT X(1)                                                         TER  470
C                                                                        TER  480
   50 IER=-1                                                             TER  490
   60 HI=N                                                               TER  500
      LOW=1                                                              TER  510
      GO TO 90                                                           TER  520
C                                                                        TER  530
```

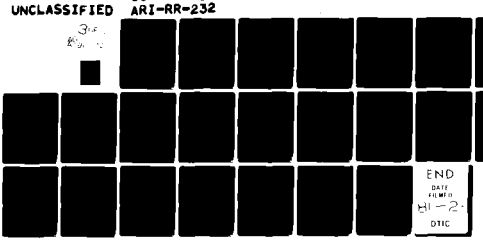
```
C     XC GT X(NPTS)                                                    TER  540
C                                                                      TER  550
   70 IER=1                                                            TER  560
   80 LOW=NPTS - N + 1                                                 TER  570
      HI=NPTS                                                          TER  580
C                                                                      TER  590
C     INTERPOLATE                                                      TER  600
C                                                                      TER  610
   90 CON=1.                                                           TER  620
      Y1(1)=Y(LOW)                                                     TER  630
      TERP=Y(LOW)                                                      TER  640
      IM=LOW - 1                                                       TER  650
      IL=LOW + 1                                                       TER  660
      DO 110 K=IL,HI                                                   TER  670
      VAL=TERP                                                         TER  680
      IA=K - LOW                                                       TER  690
      IS=IA + 1                                                        TER  700
      Y1(IS)=Y(K)                                                      TER  710
      DO 100 I=1,IA                                                    TER  720
      IR=IM + I                                                        TER  730
  100 Y1(IS) = (Y1(I)-Y1(IS))/(X(IR)-X(K))                             TER  740
      CON=CON*(XC-X(K-1))                                              TER  750
  110 TERP=VAL + CON*Y1(IS)                                            TER  760
      RETURN                                                           TER  770
  120 TERP=Y(I)                                                        TER  780
      RETURN                                                           TER  790
      END                                                              TER  800
```

APPENDIX E

SAMPLE CASES

AD-A091 972 AERODYNE RESEARCH INC BEDFORD MA CENTER FOR ELECTRO--ETC F/G 4/1
ADDITION OF A 5/CM SPECTRAL RESOLUTION BAND MODEL OPTION TO LOW--ETC(U)
OCT 80 D C ROBERTSON, L S BERNSTEIN, R HAIMES N60530-80-C-0087

UNCLASSIFIED ARI-RR-232 NL



```
  3 1  2  0  0                 1             275.                IJ
      100.         0.       180.       0.0
     1900.     2500.         5.
  4
BMOD - NADIR VEWING - GRND TO SPACE
 1 3 3
         6.
         5.
 10
  4
BMOD - TRIANG SLIT - 20CM-1
 2 3 3 3          40.         5.
        -1.        0.         1.
         0.        1.         0.
         6.     1900.     2500.       100.        9
         5.       0.0   4.0E-07   0.8E-07        9
  3  1  2  0  1                1             275.                0J
  0
LOW5 - NADIR VEWING - GRND TO SPACE
 1 3 3
         6.     1900.     2500.       100.        9
         5.       0.0   4.0E-07   0.8E-07        9
```

```
 1 PROGRAM WILL BE EXECUTED IN THE EMISSION MODE
 THE SCM-1 BAND MODEL OPTION WILL BE USED
  3  1  2  0  0  0  0  0  0  0  0  1      0.000    275.000  0  0       0.000 1
           100.000      0.000    180.000      0.000      0.000
          H1=100.000KM,H2=  0.000KM,ANGLE=180.0000GEOM. RANGE = 100.00KM,BETA=-0.00000
 1900.000  2500.000      5.000
```

SLANT PATH BETWEEN ALTITUDES H1 AND H2 WHERE H1 =100.000 KM H2 = 0.000 KM,ZENITH ANGLE =180.000 DEGREES

HAZE MODEL = 23.0 KM VISUAL RANGE AT SEA LEVEL

MODEL ATMOSPHERE 3 = MIDLATITUDE WINTER

HAZE MODEL 1 = RURAL VIS= 23.0KM

SEASON = FAL WINT

VERTICAL PROFILE AEROSOL MODEL = STR BKGR

FREQUENCY RANGE V1= 1900.0 CM-1 TO V2= 2500.0 CM-1 FOR DV = 5.0 CM-1 (4.00 - 5.26 MICRONS)

1

HORIZONTAL PROFILES

ID	ALT	P	T	H2O	CO2*	O3	N2	H2O(CON)	MOLS	(N-1)	O3(UV)
1	0.00	1018.000	272.200	3.500E-01	1.008E 00	2.800E-03	8.121E-01	3.288E-03	1.008E 00	2.741E-04	2.800E-03
2	1.00	897.300	268.700	2.500E-01	9.005E-01	2.520E-03	6.433E-01	1.862E-03	9.005E-01	2.446E-04	2.520E-03
3	2.00	789.700	265.200	1.800E-01	8.029E-01	2.287E-03	5.082E-01	1.074E-03	8.029E-01	2.180E-04	2.287E-03
4	3.00	693.800	261.700	1.200E-01	7.149E-01	2.287E-03	4.002E-01	5.453E-04	7.149E-01	1.948E-04	2.287E-03
5	4.00	608.100	255.700	6.600E-02	6.413E-01	2.287E-03	3.183E-01	2.116E-04	6.413E-01	1.745E-04	2.287E-03
6	5.00	531.300	249.700	3.800E-02	5.737E-01	2.707E-03	2.518E-01	9.059E-05	5.737E-01	1.560E-04	2.707E-03
7	6.00	462.700	243.700	2.100E-02	5.120E-01	2.987E-03	1.981E-01	3.724E-05	5.120E-01	1.390E-04	2.987E-03
8	7.00	401.600	237.700	8.500E-03	4.556E-01	3.593E-03	1.549E-01	1.022E-05	4.556E-01	1.235E-04	3.593E-03
9	8.00	347.300	231.700	3.500E-03	4.042E-01	4.200E-03	1.204E-01	3.099E-06	4.042E-01	1.094E-04	4.200E-03
10	9.00	299.200	225.700	1.600E-03	3.575E-01	5.600E-03	9.292E-02	1.120E-06	3.575E-01	9.664E-05	5.600E-03
11	10.00	256.800	219.700	7.500E-04	3.152E-01	7.467E-03	7.127E-02	4.268E-07	3.152E-01	8.415E-05	7.467E-03
12	11.00	219.900	219.200	6.900E-04	2.705E-01	9.800E-03	5.244E-02	3.396E-07	2.705E-01	7.220E-05	9.800E-03
13	12.00	188.200	218.700	6.000E-04	2.320E-01	1.213E-02	3.854E-02	2.537E-07	2.320E-01	6.192E-05	1.213E-02
14	13.00	161.000	218.200	1.800E-04	1.990E-01	1.400E-02	2.830E-02	6.003E-08	1.990E-01	5.311E-05	1.400E-02
15	14.00	137.800	217.700	1.000E-04	1.707E-01	1.493E-02	2.081E-02	2.809E-08	1.707E-01	4.553E-05	1.493E-02
16	15.00	117.800	217.200	7.600E-05	1.462E-01	1.587E-02	1.526E-02	1.819E-08	1.462E-01	3.901E-05	1.587E-02
17	16.00	100.700	216.700	6.400E-05	1.253E-01	1.680E-02	1.119E-02	1.310E-08	1.253E-01	3.343E-05	1.680E-02
18	17.00	86.100	216.200	5.600E-05	1.074E-01	1.820E-02	8.207E-03	9.811E-09	1.074E-01	2.863E-05	1.820E-02
19	18.00	73.500	215.700	5.000E-05	9.188E-02	1.913E-02	6.002E-03	7.492E-09	9.188E-02	2.451E-05	1.913E-02
20	19.00	62.800	215.200	4.900E-05	7.869E-02	2.007E-02	4.397E-03	6.306E-09	7.869E-02	2.097E-05	2.007E-02
21	20.00	53.700	215.200	4.500E-05	6.729E-02	2.100E-02	3.215E-03	4.966E-09	6.729E-02	1.791E-05	2.100E-02
22	21.00	45.800	215.200	5.100E-05	5.739E-02	2.007E-02	2.339E-03	4.862E-09	5.719E-02	1.528E-05	2.007E-02
23	22.00	39.100	215.200	5.100E-05	4.899E-02	2.007E-02	1.704E-03	4.187E-09	4.899E-02	1.305E-05	2.007E-02
24	23.00	33.400	215.200	5.400E-05	4.185E-02	1.820E-02	1.244E-03	3.841E-09	4.185E-02	1.116E-05	1.820E-02
25	24.00	28.600	215.200	6.000E-05	3.584E-02	1.680E-02	9.119E-04	3.734E-09	3.584E-02	9.523E-06	1.680E-02
26	25.00	24.300	215.200	6.700E-05	3.045E-02	1.587E-02	6.583E-04	3.646E-09	3.045E-02	6.353E-06	1.587E-02
27	30.00	11.100	217.400	3.600E-05	1.377E-02	8.867E-03	1.353E-04	9.047E-10	1.377E-02	2.859E-06	8.867E-03
28	35.00	5.180	227.800	1.100E-05	6.132E-03	4.293E-03	2.747E-05	1.203E-10	6.132E-03	1.284E-06	4.293E-03

29	40.00	2.530	243.200	4.300E-06	2.805E-03	1.913E-03	5.940E-06	2.225E-11	2.805E-03	5.964E-07	1.913E-03
30	45.00	1.290	258.500	1.900E-06	1.346E-03	6.067E-04	1.409E-06	4.942E-12	1.346E-03	2.928E-07	6.067E-04
31	50.00	0.682	265.700	6.300E-07	6.921E-04	2.007E-04	3.780E-07	8.579E-13	6.921E-04	1.073E-07	2.007E-04
32	70.00	0.047	230.700	1.400E-08	5.458E-05	4.013E-06	2.190E-09	1.302E-15	5.458E-05	7.898E-09	4.013E-06
33	100.00	0.000	210.200	1.000E-10	3.848E-07	2.007E-09	1.039E-13	6.038E-20	3.848E-07	5.529E-11	2.007E-09
34	99999.00	0.000	210.000	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01

HORIZONTAL PROFILES

ID	ALT	P	T	H2O(AN)	HNO3	AER1	AER2	AER3	AER4	(AER1*RH)	RH
1	0.00	1018.000	272.200	6.488E-02	0.000E-01	1.580E-01	0.000E-01	0.000E-01	0.000E-01	1.217E 01	7.703E 01
2	1.00	897.300	268.700	4.330E-02	0.000E-01	9.910E-02	0.000E-01	0.000E-01	0.000E-01	6.979E 00	7.042E 01
3	2.00	789.700	265.200	2.918E-02	0.000E-01	6.210E-02	0.000E-01	0.000E-01	0.000E-01	4.061E 00	6.540E 01
4	3.00	693.800	261.700	1.820E-02	0.000E-01	0.000E-01	2.720E-02	0.000E-01	0.000E-01	0.000E-01	0.000E-01
5	4.00	608.100	255.700	9.846E-03	0.000E-01	0.000E-01	1.200E-02	0.000E-01	0.000E-01	0.000E-01	0.000E-01
6	5.00	531.300	249.700	5.604E-03	0.000E-01	0.000E-01	4.850E-03	0.000E-01	0.000E-01	0.000E-01	0.000E-01
7	6.00	462.700	243.700	3.074E-03	0.000E-01	0.000E-01	3.540E-03	0.000E-01	0.000E-01	0.000E-01	0.000E-01
8	7.00	401.600	237.700	1.239E-03	0.000E-01	0.000E-01	2.310E-03	0.000E-01	0.000E-01	0.000E-01	0.000E-01
9	8.00	347.300	231.700	5.108E-04	4.042E-35	0.000E-01	1.410E-03	0.000E-01	0.000E-01	0.000E-01	0.000E-01
10	9.00	299.200	225.700	2.348E-04	3.575E-06	0.000E-01	9.800E-04	0.000E-01	0.000E-01	0.000E-01	0.000E-01
11	10.00	256.800	219.700	1.112E-04	1.040E-05	0.000E-01	0.000E-01	7.870E-04	0.000E-01	0.000E-01	0.000E-01
12	11.00	219.900	219.200	8.884E-05	2.164E-05	0.000E-01	0.000E-01	7.140E-04	0.000E-01	0.000E-01	0.000E-01
13	12.00	188.200	218.700	6.705E-05	2.784E-05	0.000E-01	0.000E-01	6.640E-04	0.000E-01	0.000E-01	0.000E-01
14	13.00	161.000	218.200	5.745E-05	2.785E-05	0.000E-01	0.000E-01	6.230E-04	0.000E-01	0.000E-01	0.000E-01
15	14.00	137.800	217.700	8.416E-06	2.731E-05	0.000E-01	0.000E-01	6.450E-04	0.000E-01	0.000E-01	0.000E-01
16	15.00	117.800	217.200	3.547E-06	2.632E-05	0.000E-01	0.000E-01	6.430E-04	0.000E-01	0.000E-01	0.000E-01
17	16.00	100.700	216.700	4.051E-06	2.381E-05	0.000E-01	0.000E-01	6.410E-04	0.000E-01	0.000E-01	0.000E-01
18	17.00	86.100	216.200	3.074E-06	2.148E-05	0.000E-01	0.000E-01	6.000E-04	0.000E-01	0.000E-01	0.000E-01
19	18.00	73.500	215.700	2.377E-06	1.930E-05	0.000E-01	0.000E-01	5.620E-04	0.000E-01	0.000E-01	0.000E-01
20	19.00	62.800	215.200	2.020E-06	1.810E-05	0.000E-01	0.000E-01	4.910E-04	0.000E-01	0.000E-01	0.000E-01
21	20.00	53.700	215.200	1.586E-06	2.019E-05	0.000E-01	0.000E-01	4.230E-04	0.000E-01	0.000E-01	0.000E-01
22	21.00	45.800	215.200	1.533E-06	2.123E-05	0.000E-01	0.000E-01	3.520E-04	0.000E-01	0.000E-01	0.000E-01
23	22.00	39.100	215.200	1.309E-06	2.058E-05	0.000E-01	0.000E-01	2.950E-04	0.000E-01	0.000E-01	0.000E-01
24	23.00	33.400	215.200	1.184E-06	2.176E-05	0.000E-01	0.000E-01	2.420E-04	0.000E-01	0.000E-01	0.000E-01
25	24.00	28.600	215.200	1.126E-06	2.150E-05	0.000E-01	0.000E-01	1.900E-04	0.000E-01	0.000E-01	0.000E-01
26	25.00	24.300	215.200	1.069E-06	1.157E-05	0.000E-01	0.000E-01	1.500E-04	0.000E-01	0.000E-01	0.000E-01
27	30.00	11.100	217.400	2.462E-07	3.580E-06	0.000E-01	0.000E-01	3.320E-05	0.000E-01	0.000E-01	0.000E-01
28	35.00	5.180	227.800	2.644E-08	1.349E-07	0.000E-01	0.000E-01	0.000E-01	1.640E-05	0.000E-01	0.000E-01
29	40.00	2.530	243.200	3.469E-09	2.805E-37	0.000E-01	0.000E-01	0.000E-01	7.990E-06	0.000E-01	0.000E-01
30	45.00	1.290	258.500	5.627E-10	0.000E-01	0.000E-01	0.000E-01	0.000E-01	4.010E-06	0.000E-01	0.000E-01
31	50.00	0.682	265.700	8.562E-11	0.000E-01	0.000E-01	0.000E-01	0.000E-01	2.100E-06	0.000E-01	0.000E-01
32	70.00	0.047	230.700	2.816E-13	0.000E-01	0.000E-01	0.000E-01	0.000E-01	1.600E-07	0.000E-01	0.000E-01
33	100.00	0.000	210.200	2.286E-17	0.000E-01	0.000E-01	0.000E-01	0.000E-01	9.310E-10	0.000E-01	0.000E-01
34	99999.00	0.000	210.000	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01

FROM POINT\ HEIGHT= 100.0000 KM,N= 33,MP= 1,REF. INDEX ABOVE & BELOW X= 0.0000E 00 0.0000E 00,IP= 1
EQUIV. ABSORBER AMOUNTS PER KM AT X= 0.100E-09 0.385E-06 0.201E-08 0.104E-12 0.604E-19 0.385E-06 0.000E 00 0.201E-08

TX(12-14)= 0.000E 00 0.000E 00 0.931E-09

FROM POINT\ HEIGHT= 0.0000 KM,N= 1,MP= 1,REF. INDEX ABOVE & BELOW X= 0.2719E-03 0.0000E 00,IP= 1
EQUIV. ABSORBER AMOUNTS PER KM AT X= 0.350E 00 0.101E 01 0.280E-02 0.812E 00 0.329E-02 0.101E 01 0.158E 00 0.280E-02

TH(12-14)= 0.000E 00 0.000E 00 0.000E 00
RMIN = -6371.223

VERTICAL PROFILES

ID	ALT	H2O	CO2+ H2O(4M)	O3 HNO3	N2 AER2	H2O(IOM) AER3	NOLS AER4	AER1	O3(UV)	PSI	PHI	BETA	THETA	R DR
32	100.000	8.430E-08	3.281E-04	1.583E-05	6.600E-09	3.915E-15	3.281E-04	0.000E-01	1.583E-05	-0.000	0.000	0.000	180.000	30.0
	70.000		8.967E-13	0.000E-01	0.000E-01	0.000E-01	9.272E-07							30.00
31	70.000	3.320E-06	5.348E-03	1.021E-03	1.466E-06	2.643E-12	5.348E-03	0.000E-01	1.021E-03	-0.000	0.000	0.000	180.000	50.0
	50.000		2.994E-10	0.000E-01	0.000E-01	0.000E-01	1.600E-05							20.00
30	50.000	9.071E-06	1.026E-02	2.855E-03	5.382E-06	1.430E-11	1.026E-02	0.000E-01	2.855E-03	-0.000	0.000	0.000	180.000	55.0
	45.000		1.566E-09	0.000E-01	0.000E-01	0.000E-01	3.076E-05							5.00
29	45.000	2.376E-05	2.019E-02	8.543E-03	2.113E-05	7.180E-11	2.019E-02	0.000E-01	8.543E-03	-0.000	0.000	0.000	180.000	60.0
	40.000		9.553E-09	0.000E-01	0.000E-01	0.000E-01	5.962E-05							5.00
28	40.000	5.942E-05	4.146E-02	2.326E-02	9.140E-05	3.621E-10	4.146E-02	0.000E-01	2.326E-02	-0.000	0.000	0.000	180.000	65.0
	35.000		6.609E-08	9.066E-09	0.000E-01	0.000E-01	1.181E-04							5.00
27	35.000	1.640E-04	8.864E-02	5.478E-02	4.294E-04	2.305E-09	8.864E-02	0.000E-01	5.478E-02	-0.000	0.000	0.000	180.000	70.0
	30.000		5.584E-07	5.261E-06	0.000E-01	0.000E-01	1.181E-04							5.00
26	30.000	4.142E-04	1.937E-01	1.149E-01	2.081E-03	1.213E-08	1.937E-01	0.000E-01	1.149E-01	-0.000	0.000	0.000	180.000	75.0
	25.000		3.350E-06	3.930E-05	0.000E-01	3.870E-04	1.181E-04							5.00
25	25.000	4.775E-04	2.266E-01	1.312E-01	2.857E-03	1.581E-08	2.266E-01	0.000E-01	1.312E-01	-0.000	0.000	0.000	180.000	76.0
	24.000		4.453E-06	5.528E-05	0.000E-01	5.558E-04	1.181E-04							1.00
24	24.000	5.343E-04	2.654E-01	1.486E-01	3.925E-03	1.960E-08	2.654E-01	0.000E-01	1.486E-01	-0.000	0.000	0.000	180.000	77.0
	23.000		5.606E-06	7.688E-05	0.000E-01	7.705E-04	1.181E-04							1.00
23	23.000	5.868E-04	3.107E-01	1.678E-01	5.386E-03	2.361E-08	3.107E-01	0.000E-01	1.678E-01	-0.000	0.000	0.000	180.000	78.0
	22.000		6.851E-06	9.804E-05	0.000E-01	1.038E-03	1.181E-04							1.00
22	22.000	6.378E-04	3.637E-01	1.878E-01	7.390E-03	2.812E-08	3.637E-01	0.000E-01	1.878E-01	-0.000	0.000	0.000	180.000	79.0
	21.000		8.268E-06	1.189E-04	0.000E-01	1.360E-03	1.181E-04							1.00
21	21.000	6.857E-04	4.259E-01	2.083E-01	1.014E-02	3.303E-08	4.259E-01	0.000E-01	2.083E-01	-0.000	0.000	0.000	180.000	80.0
	20.000		9.826E-06	1.396E-04	0.000E-01	1.746E-03	1.181E-04							1.00
20	20.000	7.326E-04	4.986E-01	2.288E-01	1.391E-02	3.863E-08	4.986E-01	0.000E-01	2.288E-01	-0.000	0.000	0.000	180.000	81.0
	19.000		1.162E-05	1.587E-04	0.000E-01	2.202E-03	1.181E-04							1.00
19	19.000	7.820E-04	5.836E-01	2.484E-01	1.906E-02	4.550E-08	5.836E-01	0.000E-01	2.484E-01	-0.000	0.000	0.000	180.000	82.0
	18.000		1.381E-05	1.774E-04	0.000E-01	2.727E-03	1.181E-04							1.00
18	18.000	8.348E-04	6.828E-01	2.670E-01	2.609E-02	5.409E-08	6.828E-01	0.000E-01	2.670E-01	-0.000	0.000	0.000	180.000	83.0
	17.000		1.651E-05	1.977E-04	0.000E-01	3.307E-03	1.181E-04							1.00
17	17.000	8.944E-04	7.987E-01	2.845E-01	3.569E-02	6.544E-08	7.987E-01	0.000E-01	2.845E-01	-0.000	0.000	0.000	180.000	84.0
	16.000		2.005E-05	2.203E-04	0.000E-01	3.925E-03	1.181E-04							1.00
16	16.000	9.643E-04	9.338E-01	3.008E-01	4.878E-02	8.090E-08	9.338E-01	0.000E-01	3.008E-01	-0.000	0.000	0.000	180.000	85.0
	15.000		2.479E-05	2.453E-04	0.000E-01	4.566E-03	1.181E-04							1.00
15	15.000	1.052E-03	1.092E 00	3.161E-01	6.664E-02	1.037E-07	1.092E 00	0.000E-01	3.161E-01	-0.000	0.000	0.000	180.000	86.0
	14.000		3.167E-05	2.720E-04	0.000E-01	5.209E-03	1.181E-04							1.00
14	14.000	1.187E-03	1.276E 00	3.306E-01	9.096E-02	1.456E-07	1.276E 00	0.000E-01	3.306E-01	-0.000	0.000	0.000	180.000	87.0
	13.000		4.403E-05	2.996E-04	0.000E-01	5.842E-03	1.181E-04							1.00
13	13.000	1.534E-03	1.491E 00	3.436E-01	1.241E-01	2.799E-07	1.491E 00	0.000E-01	3.436E-01	-0.000	0.000	0.000	180.000	88.0
	12.000		8.086E-05	3.274E-04	0.000E-01	6.485E-03	1.181E-04							1.00
12	12.000	2.179E-03	1.741E 00	3.545E-01	1.692E-01	5.743E-07	1.741E 00	0.000E-01	3.545E-01	-0.000	0.000	0.000	180.000	89.0
	11.000		1.502E-04	3.520E-04	0.000E-01	7.173E-03	1.181E-04							1.00
11	11.000	2.898E-03	2.033E 00	3.631E-01	2.305E-01	9.554E-07	2.033E 00	0.000E-01	3.631E-01	-0.000	0.000	0.000	180.000	90.0
	10.000		2.577E-04	3.673E-04	0.000E-01	7.922E-03	1.181E-04							1.00

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 10  10.000 4.017E-03 2.368E 00 3.696E-01 3.119E-01 1.672E-06 2.368E 00 0.000E-01 3.696E-01  -0.000   0.000   0.000 100.000   91.0
      9.000          4.226E-04 3.737E-04 0.000E-01 7.922E-03 1.181E-04                                                          1.00
  9   9.000 6.440E-03 2.748E 00 3.744E-01 4.177E-01 3.613E-06 2.748E 00 0.000E-01 3.744E-01  -0.000   0.000   0.000 100.000   92.0
      8.000          7.771E-04 3.737E-04 1.180E-03 7.922E-03 1.181E-04                                                          1.00
  8   8.000 1.206E-02 3.176E 00 3.783E-01 5.544E-01 9.567E-06 3.176E 00 0.000E-01 3.783E-01  -0.000   0.000   0.000 100.000   93.0
      7.000          1.597E-03 3.737E-04 2.999E-03 7.922E-03 1.181E-04                                                          1.00
  7   7.000 2.587E-02 3.659E 00 3.816E-01 7.298E-01 3.044E-05 3.659E 00 0.000E-01 3.816E-01  -0.000   0.000   0.000 100.000   94.0
      6.000          3.615E-03 3.737E-04 5.878E-03 7.922E-03 1.181E-04                                                          1.00
  6   6.000 5.430E-02 4.201E 00 3.844E-01 9.533E-01 9.038E-05 4.201E 00 0.000E-01 3.844E-01  -0.000   0.000   0.000 100.000   95.0
      5.000          7.823E-03 3.737E-04 1.003E-02 7.922E-03 1.181E-04                                                          1.00
  5   5.000 1.051E-01 4.807E 00 3.869E-01 1.237E 00 2.328E-04 4.807E 00 0.000E-01 3.869E-01  -0.000   0.000   0.000 100.000   96.0
      4.000          1.534E-02 3.737E-04 1.791E-02 7.922E-03 1.181E-04                                                          1.00
  4   4.000 1.954E-01 5.404E 00 3.892E-01 1.594E 00 5.851E-04 5.404E 00 0.000E-01 3.892E-01  -0.000   0.000   0.000 100.000   97.0
      3.000          2.893E-02 3.737E-04 3.648E-02 7.922E-03 1.181E-04                                                          1.00
  3   3.000 3.433E-01 6.241E 00 3.915E-01 2.046E 00 1.364E-03 6.241E 00 0.000E-01 3.915E-01  -0.000   0.000   0.000 100.000   98.0
      2.000          5.218E-02 3.737E-04 3.648E-02 7.922E-03 1.181E-04                                                          1.00
  2   2.000 5.539E-01 7.090E 00 3.939E-01 2.618E 00 2.793E-03 7.090E 00 7.897E-02 3.939E-01  -0.000   0.000   0.000 100.000   99.0
      1.000          8.787E-02 3.737E-04 3.648E-02 7.922E-03 1.181E-04                                                          1.00
  1   1.000 8.527E-01 8.042E 00 3.965E-01 3.341E 00 5.297E-03 8.042E 00 2.051E-01 3.965E-01  -0.000   0.000   0.000 100.000   100.0
      0.000          1.412E-01 3.737E-04 3.648E-02 7.922E-03 1.181E-04                                                          1.00
-6371.223

        EQUIVALENT SEA LEVEL ABSORBER AMOUNTS

                  WATER VAPOUR      CO2 ETC.        OZONE      NITROGEN (CONT)   H2O  (CONT)      MOL  SCAT      AER1        OZONE(U-V
                    GM CM-2           KM           ATM CM           KM           GM CM-2           KM                        ATM CM
                                                                                                                          NITRIC ACID

        W(1-8)=     0.853E 00      0.804E 01      0.397E 00      0.334E 01      0.530E-02      0.804E 01      0.205E 00      0.397E 00
                                                                                0.141E 00                                    0.374E-03

                                AER2           AER3           AER4       R.H. MEAN
        W(12-15)=       3.648E-02      7.922E-03      1.181E-04      7.168E 01
 ICH      1    6   10   15
 EXTINCTION AND ABSORPTION COEFFICIENTS
32  1

                CUMULATIVE ABSORBER AMOUNTS FOR THE ATMOSPHERIC PAT,

       H2O        CO2+          O3          N2         H2O C       MOL S        AER1        O3 SV       H2O C       HNO3        TAVE        PAVE
  1 8.430E-08 3.281E-04 1.583E-05 6.600E-09 3.915E-13 3.281E-04 0.000E-01 1.583E-05 8.967E-13 0.000E-01   220.450       0.023
  2 3.236E-06 5.019E-03 1.809E-03 1.446E-06 2.643E-12 5.348E-03 0.000E-01 1.021E-03 2.994E-10 0.000E-01   248.200       0.364
  3 5.751E-06 4.913E-03 1.834E-03 5.382E-06 1.430E-11 1.026E-02 0.000E-01 2.855E-03 1.566E-09 0.000E-01   262.100       0.986
  4 1.469E-05 9.933E-03 5.687E-03 2.113E-05 7.180E-11 2.019E-02 0.000E-01 8.543E-03 9.553E-09 0.000E-01   250.850       1.910
  5 3.566E-05 2.126E-02 1.472E-02 9.140E-05 3.621E-10 4.146E-02 0.000E-01 2.324E-02 6.609E-08 9.866E-09   235.500       3.855
  6 1.054E-04 4.718E-02 3.152E-02 4.294E-04 2.305E-09 8.864E-02 0.000E-01 5.478E-02 5.584E-07 5.261E-06   222.600       8.140
  7 2.494E-04 1.050E-01 6.811E-02 2.081E-03 1.215E-08 1.937E-01 0.000E-01 1.149E-01 3.358E-06 3.930E-05   216.300      17.700
  8 6.327E-05 3.298E-02 1.629E-02 2.857E-03 1.581E-08 2.266E-01 0.000E-01 1.312E-01 4.453E-06 5.528E-05   215.200      26.450
  9 5.686E-05 3.871E-02 1.746E-02 3.925E-03 1.960E-08 2.654E-01 0.000E-01 1.486E-01 5.606E-06 7.688E-05   215.200      31.000
 10 5.247E-05 4.531E-02 1.911E-02 5.386E-03 2.361E-08 3.107E-01 0.000E-01 1.678E-01 6.851E-06 9.804E-05   215.200      36.250
 11 5.097E-05 5.304E-02 2.005E-02 7.390E-03 2.812E-08 3.637E-01 0.000E-01 1.878E-01 8.268E-06 1.189E-04   215.200      42.450
 12 4.789E-05 6.214E-02 2.051E-02 1.014E-02 3.303E-08 4.259E-01 0.000E-01 2.083E-01 9.826E-06 1.396E-04   215.200      49.750
 13 4.691E-05 7.274E-02 2.050E-02 1.391E-02 3.863E-08 4.986E-01 0.000E-01 2.288E-01 1.162E-05 1.587E-04   215.200      58.250
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14	4.942E-05	8.498E-02	1.956E-02	1.906E-02	4.550E-08	5.836E-01	0.000E-01	2.484E-01	1.381E-05	1.774E-04	215.450	68.150
15	5.284E-05	9.924E-02	1.863E-02	2.609E-02	5.409E-08	6.828E-01	0.000E-01	2.670E-01	1.651E-05	1.977E-04	215.950	79.800
16	5.978E-05	1.159E-01	1.745E-02	3.569E-02	6.544E-08	7.987E-01	0.000E-01	2.845E-01	2.005E-05	2.203E-04	216.450	93.400
17	6.965E-05	1.352E-01	1.629E-02	4.878E-02	8.090E-08	9.338E-01	0.000E-01	3.008E-01	2.479E-05	2.453E-04	216.950	109.250
18	8.733E-05	1.579E-01	1.537E-02	6.664E-02	1.037E-07	1.092E 00	0.000E-01	3.161E-01	3.167E-05	2.720E-04	217.450	127.800
19	1.359E-04	1.841E-01	1.444E-02	9.096E-02	1.456E-07	1.276E 00	0.000E-01	3.306E-01	4.403E-05	2.996E-04	217.950	149.400
20	3.486E-04	2.149E-01	1.304E-02	1.241E-01	2.799E-07	1.491E 00	0.000E-01	3.436E-01	8.086E-05	3.274E-04	218.450	174.600
21	6.434E-04	2.506E-01	1.092E-02	1.692E-01	5.743E-07	1.741E 00	0.000E-01	3.545E-01	1.582E-04	3.520E-04	218.950	204.050
22	7.187E-04	2.919E-01	8.570E-03	2.305E-01	9.534E-07	2.033E 00	0.000E-01	3.631E-01	2.577E-04	3.673E-04	219.450	238.350
23	1.119E-03	3.349E-01	6.470E-03	3.119E-01	1.672E-06	2.368E 00	0.000E-01	3.696E-01	4.226E-04	3.737E-04	222.700	278.000
24	2.423E-03	3.797E-01	4.858E-03	4.177E-01	3.613E-06	2.748E 00	0.000E-01	3.744E-01	7.771E-04	3.737E-04	228.700	323.250
25	5.623E-03	4.285E-01	3.881E-03	5.544E-01	9.567E-06	3.176E 00	0.000E-01	3.783E-01	1.597E-03	3.737E-04	234.700	374.450
26	1.301E-02	4.828E-01	3.277E-03	7.298E-01	3.044E-05	3.659E 00	0.000E-01	3.816E-01	3.615E-03	3.737E-04	240.700	432.150
27	2.863E-02	5.416E-01	2.841E-03	9.533E-01	9.038E-05	4.201E 00	0.000E-01	3.844E-01	7.823E-03	3.737E-04	246.700	497.000
28	5.064E-02	6.059E-01	2.487E-03	1.237E 00	2.328E-04	4.807E 00	0.000E-01	3.869E-01	1.534E-02	3.737E-04	252.700	569.700
29	9.029E-02	6.771E-01	2.286E-03	1.594E 00	5.851E-04	5.484E 00	0.000E-01	3.892E-01	2.893E-02	3.737E-04	258.700	650.950
30	1.479E-01	7.575E-01	2.285E-03	2.046E 00	1.364E-03	6.241E 00	0.000E-01	3.915E-01	5.218E-02	3.737E-04	263.450	741.750
31	2.126E-01	8.487E-01	2.396E-03	2.618E 00	2.793E-03	7.090E 00	7.897E-02	3.939E-01	8.787E-02	3.737E-04	266.950	843.500
32	2.968E-01	9.522E-01	2.654E-03	3.341E 00	5.297E-03	8.042E 00	2.051E-01	3.965E-01	1.412E-01	3.737E-04	270.450	957.650

ID	AER2	AER3	AER4
1	0.000E-01	0.000E-01	9.272E-07
2	0.000E-01	0.000E-01	1.600E-05
3	0.000E-01	0.000E-01	3.076E-05
4	0.000E-01	0.000E-01	5.962E-05
5	0.000E-01	0.000E-01	1.181E-04
6	0.000E-01	0.000E-01	1.181E-04
7	0.000E-01	3.870E-04	1.181E-04
8	0.000E-01	5.558E-04	1.181E-04
9	0.000E-01	7.705E-04	1.181E-04
10	0.000E-01	1.038E-03	1.181E-04
11	0.000E-01	1.360E-03	1.181E-04
12	0.000E-01	1.746E-03	1.181E-04
13	0.000E-01	2.202E-03	1.181E-04
14	0.000E-01	2.727E-03	1.181E-04
15	0.000E-01	3.307E-03	1.181E-04
16	0.000E-01	3.925E-03	1.181E-04
17	0.000E-01	4.566E-03	1.181E-04
18	0.000E-01	5.209E-03	1.181E-04
19	0.000E-01	5.842E-03	1.181E-04
20	0.000E-01	6.485E-03	1.181E-04
21	0.000E-01	7.173E-03	1.181E-04
22	0.000E-01	7.922E-03	1.181E-04
23	0.000E-01	7.922E-03	1.181E-04
24	1.180E-03	7.922E-03	1.181E-04
25	2.999E-03	7.922E-03	1.181E-04
26	5.878E-03	7.922E-03	1.181E-04
27	1.003E-02	7.922E-03	1.181E-04
28	1.791E-02	7.922E-03	1.181E-04
29	3.648E-02	7.922E-03	1.181E-04
30	3.648E-02	7.922E-03	1.181E-04
31	3.648E-02	7.922E-03	1.181E-04
32	3.648E-02	7.922E-03	1.181E-04

		RADIANCE(WATTS/CM2-STER-XXX)			
FR(CM-1)	WVL(MICRON)	PER CM-1	PER MICRON	INTEGRAL	TRANS
1900.0	5.263158	0.30192E-06	0.10899E-03	0.75479E-06	0.369922
1905.0	5.249343	0.25153E-06	0.91282E-04	0.20125E-05	0.217733
1910.0	5.235601	0.16495E-06	0.60177E-04	0.28372E-05	0.021211
1915.0	5.221931	0.25401E-06	0.93151E-04	0.41073E-05	0.205825
1920.0	5.208333	0.11935E-06	0.43997E-04	0.47040E-05	0.000865
1925.0	5.194805	0.18011E-06	0.66741E-04	0.56046E-05	0.042556
1930.0	5.181347	0.28513E-06	0.10621E-03	0.70302E-05	0.460168
1935.0	5.167958	0.22411E-06	0.83912E-04	0.81507E-05	0.272182
1940.0	5.154638	0.23529E-06	0.88554E-04	0.93272E-05	0.239903
1945.0	5.141388	0.12318E-06	0.46599E-04	0.99431E-05	0.005231
1950.0	5.128204	0.26317E-06	0.10007E-03	0.11259E-04	0.431814
1955.0	5.115089	0.21948E-06	0.83884E-04	0.12356E-04	0.285229
1960.0	5.102040	0.23221E-06	0.89206E-04	0.13517E-04	0.366190
1965.0	5.089058	0.16841E-06	0.65026E-04	0.14359E-04	0.100269
1970.0	5.076141	0.27824E-06	0.10798E-03	0.15751E-04	0.741280
1975.0	5.063291	0.26120E-06	0.10189E-03	0.17057E-04	0.677632
1980.0	5.050505	0.27081E-06	0.10617E-03	0.18411E-04	0.782680
1985.0	5.037783	0.25542E-06	0.10064E-03	0.19688E-04	0.672019
1990.0	5.025126	0.13106E-06	0.51902E-04	0.20343E-04	0.042532
1995.0	5.012531	0.19254E-06	0.76633E-04	0.21306E-04	0.306863
2000.0	5.000000	0.21615E-06	0.86459E-04	0.22387E-04	0.518288
2005.0	4.987531	0.25263E-06	0.10156E-03	0.23650E-04	0.851459
2010.0	4.975124	0.20590E-06	0.83186E-04	0.24679E-04	0.485380
2015.0	4.962779	0.16792E-06	0.68179E-04	0.25519E-04	0.259207
2020.0	4.950495	0.18166E-06	0.74124E-04	0.26427E-04	0.367766
2025.0	4.938272	0.18889E-06	0.77457E-04	0.27372E-04	0.442197
2030.0	4.926108	0.23340E-06	0.96182E-04	0.28539E-04	0.908272
2035.0	4.914004	0.21914E-06	0.90752E-04	0.29634E-04	0.796689
2040.0	4.901960	0.16006E-06	0.66612E-04	0.30435E-04	0.328031
2045.0	4.889976	0.17774E-06	0.74330E-04	0.31323E-04	0.529037
2050.0	4.878048	0.18075E-06	0.75959E-04	0.32227E-04	0.670364
2055.0	4.866179	0.17896E-06	0.75573E-04	0.33122E-04	0.681666
2060.0	4.854368	0.15210E-06	0.64546E-04	0.33882E-04	0.470045
2065.0	4.842614	0.11959E-06	0.50995E-04	0.34480E-04	0.228293
2070.0	4.830917	0.15849E-06	0.67912E-04	0.35273E-04	0.630561
2075.0	4.819277	0.98463E-07	0.42394E-04	0.35765E-04	0.246381
2080.0	4.807692	0.11315E-06	0.48955E-04	0.36331E-04	0.336759
2085.0	4.796163	0.14534E-06	0.63181E-04	0.37057E-04	0.589473
2090.0	4.784689	0.12379E-06	0.54072E-04	0.37676E-04	0.392666
2095.0	4.773270	0.12627E-06	0.55420E-04	0.38308E-04	0.502343
2100.0	4.761905	0.13652E-06	0.60204E-04	0.38990E-04	0.627800
2105.0	4.750593	0.12237E-06	0.54224E-04	0.39602E-04	0.535267
2110.0	4.739336	0.13316E-06	0.59286E-04	0.40268E-04	0.651515
2115.0	4.728132	0.11918E-06	0.53314E-04	0.40864E-04	0.668719
2120.0	4.716981	0.10487E-06	0.47133E-04	0.41388E-04	0.513394
2125.0	4.705882	0.10226E-06	0.46178E-04	0.41900E-04	0.487115
2130.0	4.694836	0.11988E-06	0.54388E-04	0.42499E-04	0.632634
2135.0	4.683840	0.13504E-06	0.61553E-04	0.43174E-04	0.636697
2140.0	4.672896	0.14114E-06	0.64635E-04	0.43880E-04	0.734004
2145.0	4.662004	0.13894E-06	0.63928E-04	0.44575E-04	0.749641
2150.0	4.651162	0.13969E-06	0.64572E-04	0.45273E-04	0.837184
2155.0	4.640370	0.12877E-06	0.59799E-04	0.45917E-04	0.720087

2160.0	4.629629	0.11531E-06	0.53806E-04	0.46493E-04	0.612729
2165.0	4.618937	0.11908E-06	0.55817E-04	0.47089E-04	0.684641
2170.0	4.608294	0.11498E-06	0.54143E-04	0.47664E-04	0.662876
2175.0	4.597701	0.10262E-06	0.48543E-04	0.48177E-04	0.578612
2180.0	4.587155	0.98869E-07	0.46986E-04	0.48671E-04	0.535944
2185.0	4.576658	0.78330E-07	0.37397E-04	0.49063E-04	0.350610
2190.0	4.566210	0.64976E-07	0.31163E-04	0.49388E-04	0.268996
2195.0	4.555808	0.57563E-07	0.27734E-04	0.49675E-04	0.220025
2200.0	4.545454	0.49282E-07	0.23852E-04	0.49922E-04	0.160458
2205.0	4.535147	0.41344E-07	0.20102E-04	0.50129E-04	0.111564
2210.0	4.524886	0.34699E-07	0.16947E-04	0.50302E-04	0.074570
2215.0	4.514672	0.36850E-07	0.18079E-04	0.50486E-04	0.088784
2220.0	4.504504	0.35013E-07	0.17256E-04	0.50661E-04	0.085095
2225.0	4.494382	0.42041E-07	0.20813E-04	0.50872E-04	0.144223
2230.0	4.484304	0.27561E-07	0.13706E-04	0.51009E-04	0.047550
2235.0	4.474273	0.22771E-07	0.11375E-04	0.51123E-04	0.021232
2240.0	4.464285	0.21839E-07	0.10958E-04	0.51232E-04	0.017494
2245.0	4.454343	0.21006E-07	0.10587E-04	0.51337E-04	0.020192
2250.0	4.444444	0.14981E-07	0.75839E-05	0.51412E-04	0.006100
2255.0	4.434589	0.15216E-07	0.77376E-05	0.51488E-04	0.007457
2260.0	4.424778	0.94343E-08	0.48187E-05	0.51536E-04	0.001104
2265.0	4.415010	0.79151E-08	0.40606E-05	0.51575E-04	0.000407
2270.0	4.405286	0.67660E-08	0.34864E-05	0.51609E-04	0.000093
2275.0	4.395604	0.66161E-08	0.34242E-05	0.51642E-04	0.000094
2280.0	4.385964	0.79751E-08	0.41458E-05	0.51682E-04	0.000087
2285.0	4.376368	0.81253E-08	0.42424E-05	0.51723E-04	0.000034
2290.0	4.366812	0.59089E-08	0.30987E-05	0.51752E-04	0.000001
2295.0	4.357298	0.53284E-08	0.28065E-05	0.51779E-04	0.000000
2300.0	4.347826	0.52173E-08	0.27600E-05	0.51805E-04	0.000000
2305.0	4.338394	0.48928E-08	0.25994E-05	0.51829E-04	0.000000
2310.0	4.329004	0.49120E-08	0.26211E-05	0.51854E-04	0.000001
2315.0	4.319654	0.54344E-08	0.29124E-05	0.51881E-04	0.000000
2320.0	4.310345	0.54505E-08	0.29337E-05	0.51908E-04	0.000001
2325.0	4.301075	0.65703E-08	0.35517E-05	0.51941E-04	0.000000
2330.0	4.291845	0.68772E-08	0.37336E-05	0.51976E-04	0.000000
2335.0	4.282655	0.63180E-08	0.34447E-05	0.52007E-04	0.000000
2340.0	4.273504	0.67579E-08	0.37004E-05	0.52041E-04	0.000000
2345.0	4.264392	0.63715E-08	0.35037E-05	0.52073E-04	0.000000
2350.0	4.255319	0.52404E-08	0.28940E-05	0.52099E-04	0.000000
2355.0	4.246284	0.67377E-08	0.37367E-05	0.52133E-04	0.000000
2360.0	4.237288	0.59608E-08	0.33199E-05	0.52162E-04	0.000000
2365.0	4.228330	0.59170E-08	0.33095E-05	0.52192E-04	0.000000
2370.0	4.219409	0.47188E-08	0.26505E-05	0.52216E-04	0.000000
2375.0	4.210526	0.38123E-08	0.21504E-05	0.52235E-04	0.000000
2380.0	4.201680	0.29977E-08	0.16980E-05	0.52250E-04	0.000000
2385.0	4.192872	0.60895E-08	0.34619E-05	0.52280E-04	0.000191
2390.0	4.184100	0.26038E-07	0.14873E-04	0.52410E-04	0.126078
2395.0	4.175364	0.40101E-07	0.23002E-04	0.52611E-04	0.436099
2400.0	4.166666	0.41894E-07	0.24131E-04	0.52820E-04	0.511641
2405.0	4.158004	0.42168E-07	0.24390E-04	0.53031E-04	0.542842
2410.0	4.149377	0.42223E-07	0.24524E-04	0.53242E-04	0.570119
2415.0	4.140786	0.42046E-07	0.24522E-04	0.53452E-04	0.590551
2420.0	4.132231	0.41659E-07	0.24397E-04	0.53661E-04	0.600292
2425.0	4.123711	0.41564E-07	0.24442E-04	0.53869E-04	0.628901

2430.0	4.115226	0.41172E-07	0.24312E-04	0.54074E-04	0.644368
2435.0	4.106775	0.40658E-07	0.24107E-04	0.54278E-04	0.656176
2440.0	4.098360	0.39783E-07	0.23685E-04	0.54477E-04	0.657882
2445.0	4.089979	0.39247E-07	0.23462E-04	0.54673E-04	0.669159
2450.0	4.081633	0.38653E-07	0.23201E-04	0.54866E-04	0.679576
2455.0	4.073319	0.38607E-07	0.23268E-04	0.55059E-04	0.705440
2460.0	4.065041	0.38874E-07	0.23525E-04	0.55253E-04	0.739411
2465.0	4.056795	0.38226E-07	0.23227E-04	0.55445E-04	0.746665
2470.0	4.048582	0.37293E-07	0.22752E-04	0.55631E-04	0.745324
2475.0	4.040403	0.36659E-07	0.22456E-04	0.55814E-04	0.753749
2480.0	4.032258	0.36387E-07	0.22308E-04	0.55996E-04	0.771438
2485.0	4.024144	0.36640E-07	0.22626E-04	0.56179E-04	0.806268
2490.0	4.016064	0.36333E-07	0.22527E-04	0.56361E-04	0.823955
2495.0	4.008016	0.35766E-07	0.22265E-04	0.56540E-04	0.831274
2500.0	4.000000	0.35629E-07	0.22268E-04	0.56629E-04	0.855871

INTEGRATED ABSORPTION FROM 1900 TO 2500 CM-1 = 383.73AVERAGE TRANSMITTANCE =0.3604
INTEGRATED RADIANCE = 0.56629E-04WATT CM -2 SR
RADMIN 2380.000 0.29977E-08
RADMAX 1900.000 0.30192E-06

1 MOD - NADIR VIEWING - GRND TO SPACE

NO SLIT FUNCTION USED

1 ATMOSPHERIC TRANSMITTANCE

LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE	
5.2632	1900.00	0.37	0.36992	4.7506	2105.00	0.54	0.53527	4.3290	2310.00	0.00	0.0000
5.2493	1905.00	0.22	0.21773	4.7393	2110.00	0.65	0.65152	4.3197	2315.00	0.00	0.0000
5.2356	1910.00	0.02	0.02121	4.7281	2115.00	0.47	0.46872	4.3103	2320.00	0.00	0.0000
5.2219	1915.00	0.21	0.20582	4.7170	2120.00	0.51	0.51339	4.3011	2325.00	0.00	0.0000
5.2083	1920.00	0.00	0.00087	4.7059	2125.00	0.49	0.48712	4.2918	2330.00	0.00	0.0000
5.1948	1925.00	0.04	0.04256	4.6948	2130.00	0.63	0.63263	4.2827	2335.00	0.00	0.0000
5.1813	1930.00	0.46	0.46017	4.6838	2135.00	0.64	0.63670	4.2735	2340.00	0.00	0.0000
5.1680	1935.00	0.27	0.27218	4.6729	2140.00	0.73	0.73400	4.2644	2345.00	0.00	0.0000
5.1546	1940.00	0.24	0.23990	4.6620	2145.00	0.75	0.74964	4.2553	2350.00	0.00	0.0000
5.1414	1945.00	0.01	0.00523	4.6512	2150.00	0.84	0.83718	4.2463	2355.00	0.00	0.0000
5.1282	1950.00	0.43	0.43181	4.6404	2155.00	0.72	0.72009	4.2373	2360.00	0.00	0.0000
5.1151	1955.00	0.29	0.28523	4.6296	2160.00	0.61	0.61273	4.2283	2365.00	0.00	0.0000
5.1020	1960.00	0.37	0.36619	4.6189	2165.00	0.68	0.68464	4.2194	2370.00	0.00	0.0000
5.0891	1965.00	0.10	0.10027	4.6083	2170.00	0.66	0.66288	4.2105	2375.00	0.00	0.0000
5.0761	1970.00	0.74	0.74128	4.5977	2175.00	0.58	0.57861	4.2017	2380.00	0.00	0.0000
5.0633	1975.00	0.68	0.67763	4.5872	2180.00	0.54	0.53594	4.1929	2385.00	0.00	0.0001
5.0505	1980.00	0.78	0.78268	4.5767	2185.00	0.35	0.35061	4.1841	2390.00	0.13	0.1260
5.0378	1985.00	0.67	0.67202	4.5662	2190.00	0.27	0.26900	4.1754	2395.00	0.44	0.4361
5.0251	1990.00	0.04	0.04253	4.5558	2195.00	0.22	0.22002	4.1667	2400.00	0.51	0.5116
5.0125	1995.00	0.31	0.30686	4.5455	2200.00	0.16	0.16046	4.1580	2405.00	0.54	0.5428
5.0000	2000.00	0.52	0.51829	4.5351	2205.00	0.11	0.11156	4.1494	2410.00	0.57	0.5701
4.9875	2005.00	0.85	0.85146	4.5249	2210.00	0.07	0.07457	4.1408	2415.00	0.59	0.5905
4.9751	2010.00	0.49	0.48538	4.5147	2215.00	0.09	0.08878	4.1322	2420.00	0.60	0.6002
4.9628	2015.00	0.26	0.25921	4.5045	2220.00	0.09	0.08509	4.1237	2425.00	0.63	0.6289
4.9505	2020.00	0.37	0.36777	4.4944	2225.00	0.14	0.14422	4.1152	2430.00	0.64	0.6443

4.9383	2025.00	0.44	0.44220	4.4843	2230.00	0.05	0.04755	4.1068	2435.00	0.66	0.6563
4.9261	2030.00	0.91	0.90827	4.4743	2235.00	0.02	0.02123	4.0984	2440.00	0.66	0.6578
4.9140	2035.00	0.80	0.79669	4.4643	2240.00	0.02	0.01749	4.0900	2445.00	0.67	0.6691
4.9020	2040.00	0.33	0.32803	4.4543	2245.00	0.02	0.02019	4.0816	2450.00	0.68	0.6795
4.8900	2045.00	0.53	0.52904	4.4444	2250.00	0.01	0.00610	4.0733	2455.00	0.71	0.7054
4.8780	2050.00	0.67	0.67036	4.4346	2255.00	0.01	0.00746	4.0650	2460.00	0.74	0.7394
4.8662	2055.00	0.68	0.68167	4.4248	2260.00	0.00	0.00110	4.0568	2465.00	0.75	0.7466
4.8544	2060.00	0.47	0.47005	4.4150	2265.00	0.00	0.00041	4.0486	2470.00	0.75	0.7453
4.8426	2065.00	0.23	0.22829	4.4053	2270.00	0.00	0.00009	4.0404	2475.00	0.75	0.7537
4.8309	2070.00	0.63	0.63056	4.3956	2275.00	0.00	0.00009	4.0323	2480.00	0.77	0.7716
4.8193	2075.00	0.25	0.24638	4.3860	2280.00	0.00	0.00009	4.0241	2485.00	0.81	0.8062
4.8077	2080.00	0.34	0.33676	4.3764	2285.00	0.00	0.00003	4.0161	2490.00	0.82	0.8239
4.7962	2085.00	0.59	0.58947	4.3668	2290.00	0.00	0.00000	4.0080	2495.00	0.83	0.8312
4.7847	2090.00	0.39	0.39267	4.3573	2295.00	0.00	0.00000	4.0000	2500.00	0.86	0.8538
4.7733	2095.00	0.50	0.50234	4.3478	2300.00	0.00	0.00000				
4.7619	2100.00	0.63	0.62780	4.3384	2305.00	0.00	0.00000				

1 SMOD - NADIR VEWING - GRND TO SPACE

NO SLIT FUNCTION USED

1 RADIATION (WATTS/SR/CM**2/UNITS)

V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM	V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM	V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM
1900.00	3.0192E-07	5.2632	1.090E-04	2105.00	1.2237E-07	4.7506	5.422E-05	2310.00	4.9120E-09	4.3290	2.621E-06
1905.00	2.5153E-07	5.2493	9.128E-05	2110.00	1.3316E-07	4.7393	5.929E-05	2315.00	5.4344E-09	4.3197	2.912E-06
1910.00	1.6495E-07	5.2356	6.018E-05	2115.00	1.1918E-07	4.7281	5.331E-05	2320.00	5.4505E-09	4.3103	2.934E-06
1915.00	2.5401E-07	5.2219	9.315E-05	2120.00	1.0487E-07	4.7170	4.713E-05	2325.00	6.5703E-09	4.3011	3.552E-06
1920.00	1.1935E-07	5.2083	4.400E-05	2125.00	1.0226E-07	4.7059	4.618E-05	2330.00	6.8772E-09	4.2918	3.734E-06
1925.00	1.8011E-07	5.1948	6.674E-05	2130.00	1.1988E-07	4.6948	5.439E-05	2335.00	6.3180E-09	4.2827	3.445E-06
1930.00	2.8513E-07	5.1813	1.062E-04	2135.00	1.3504E-07	4.6838	6.155E-05	2340.00	6.7579E-09	4.2735	3.700E-06
1935.00	2.2411E-07	5.1680	8.391E-05	2140.00	1.4114E-07	4.6729	6.463E-05	2345.00	6.3715E-09	4.2644	3.504E-06
1940.00	2.3529E-07	5.1546	8.855E-05	2145.00	1.3894E-07	4.6620	6.393E-05	2350.00	5.2404E-09	4.2553	2.894E-06
1945.00	1.2318E-07	5.1414	4.660E-05	2150.00	1.3969E-07	4.6512	6.457E-05	2355.00	6.7377E-09	4.2463	3.737E-06
1950.00	2.6317E-07	5.1282	1.001E-04	2155.00	1.2877E-07	4.6404	5.980E-05	2360.00	5.9608E-09	4.2373	3.320E-06
1955.00	2.1948E-07	5.1151	8.388E-05	2160.00	1.1533E-07	4.6296	5.381E-05	2365.00	5.9170E-09	4.2283	3.309E-06
1960.00	2.3221E-07	5.1020	8.921E-05	2165.00	1.1908E-07	4.6189	5.582E-05	2370.00	4.7188E-09	4.2194	2.651E-06
1965.00	1.6841E-07	5.0891	6.503E-05	2170.00	1.1498E-07	4.6083	5.414E-05	2375.00	3.8123E-09	4.2105	2.150E-06
1970.00	2.7824E-07	5.0761	1.080E-04	2175.00	1.0262E-07	4.5977	4.854E-05	2380.00	2.9977E-09	4.2017	1.698E-06
1975.00	2.6120E-07	5.0633	1.019E-04	2180.00	9.8869E-08	4.5872	4.699E-05	2385.00	6.0895E-09	4.1929	3.464E-06
1980.00	2.7081E-07	5.0505	1.062E-04	2185.00	7.8330E-08	4.5767	3.740E-05	2390.00	2.6038E-08	4.1841	1.487E-05
1985.00	2.5542E-07	5.0378	1.006E-04	2190.00	6.4976E-08	4.5662	3.116E-05	2395.00	4.0101E-08	4.1754	2.300E-05
1990.00	1.3106E-07	5.0251	5.190E-05	2195.00	5.7563E-08	4.5558	2.773E-05	2400.00	4.1894E-08	4.1667	2.413E-05
1995.00	1.9254E-07	5.0125	7.663E-05	2200.00	4.9282E-08	4.5455	2.385E-05	2405.00	4.2168E-08	4.1580	2.439E-05
2000.00	2.1615E-07	5.0000	8.646E-05	2205.00	4.1344E-08	4.5351	2.010E-05	2410.00	4.2223E-08	4.1494	2.452E-05
2005.00	2.5263E-07	4.9875	1.016E-04	2210.00	3.4699E-08	4.5249	1.695E-05	2415.00	4.2046E-08	4.1408	2.452E-05
2010.00	2.0590E-07	4.9751	8.319E-05	2215.00	3.6850E-08	4.5147	1.808E-05	2420.00	4.1659E-08	4.1322	2.440E-05
2015.00	1.6792E-07	4.9628	6.818E-05	2220.00	3.5013E-08	4.5045	1.726E-05	2425.00	4.1564E-08	4.1237	2.444E-05
2020.00	1.8166E-07	4.9505	7.412E-05	2225.00	4.2041E-08	4.4944	2.081E-05	2430.00	4.1172E-08	4.1152	2.431E-05
2025.00	1.8889E-07	4.9383	7.746E-05	2230.00	2.7561E-08	4.4843	1.371E-05	2435.00	4.0658E-08	4.1068	2.411E-05
2030.00	2.3340E-07	4.9261	9.618E-05	2235.00	2.2771E-08	4.4743	1.137E-05	2440.00	3.9783E-08	4.0984	2.369E-05
2035.00	2.1914E-07	4.9140	9.075E-05	2240.00	2.1839E-08	4.4643	1.096E-05	2445.00	3.9247E-08	4.0900	2.346E-05

2040.00	1.6006E-07	4.9020	6.661E-05	2245.00	2.1006E-08	4.4543	1.059E-05	2450.00	3.8653E-08	4.0816	2.320E-05
2045.00	1.7774E-07	4.8900	7.433E-05	2250.00	1.4981E-08	4.4444	7.584E-06	2455.00	3.8607E-08	4.0733	2.327E-05
2050.00	1.8075E-07	4.8780	7.596E-05	2255.00	1.5216E-08	4.4346	7.738E-06	2460.00	3.8874E-08	4.0650	2.353E-05
2055.00	1.7896E-07	4.8662	7.557E-05	2260.00	9.4343E-09	4.4248	4.819E-06	2465.00	3.8226E-08	4.0568	2.323E-05
2060.00	1.5210E-07	4.8544	6.455E-05	2265.00	7.9151E-09	4.4150	4.061E-06	2470.00	3.7293E-08	4.0486	2.275E-05
2065.00	1.1959E-07	4.8426	5.099E-05	2270.00	6.7660E-09	4.4053	3.486E-06	2475.00	3.6659E-08	4.0404	2.246E-05
2070.00	1.5849E-07	4.8309	6.791E-05	2275.00	6.6161E-09	4.3956	3.424E-06	2480.00	3.6387E-08	4.0323	2.238E-05
2075.00	9.8463E-08	4.8193	4.239E-05	2280.00	7.9751E-09	4.3860	4.146E-06	2485.00	3.6640E-08	4.0241	2.263E-05
2080.00	1.1315E-07	4.8077	4.896E-05	2285.00	8.1253E-09	4.3764	4.242E-06	2490.00	3.6333E-08	4.0161	2.253E-05
2085.00	1.4534E-07	4.7962	6.318E-05	2290.00	5.9089E-09	4.3668	3.099E-06	2495.00	3.5766E-08	4.0080	2.226E-05
2090.00	1.2379E-07	4.7847	5.407E-05	2295.00	5.3284E-09	4.3573	2.806E-06	2500.00	3.5629E-08	4.0000	2.227E-05
2095.00	1.2627E-07	4.7733	5.542E-05	2300.00	5.2173E-09	4.3478	2.760E-06				
2100.00	1.3652E-07	4.7619	6.020E-05	2305.00	4.8928E-09	4.3384	2.600E-06				

4

1 PROGRAM WILL BE EXECUTED IN THE TRANSMISSION MODE

10 0 0 0 0 0 0 0 0 0 0 0 0.000 0.000 0 0 0.000 0

1 BMOD - TRIANG SLIT - 20CM-1

VARIABLE SLIT FUNCTION

WIDTH= 40.00000 SHIFT= 5.00000 NO. OF DEFINING PTS= 3

YS ARE 0.000 1.000 0.000

XS ARE -1.000 0.000 1.000

1 ATMOSPHERIC TRANSMITTANCE

LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE	
5.2083	1920.00	0.14	0.13758	4.7393	2110.00	0.56	0.55562	4.3678	2300.00	0.00	0.0000
5.1948	1925.00	0.17	0.17315	4.7281	2115.00	0.54	0.54218	4.3384	2305.00	0.00	0.0000
5.1813	1930.00	0.22	0.21734	4.7170	2120.00	0.54	0.54133	4.3290	2310.00	0.00	0.0000
5.1680	1935.00	0.23	0.23232	4.7059	2125.00	0.56	0.56143	4.3197	2315.00	0.00	0.0000
5.1546	1940.00	0.24	0.24398	4.6948	2130.00	0.60	0.60095	4.3103	2320.00	0.00	0.0000
5.1414	1945.00	0.25	0.24858	4.6838	2135.00	0.65	0.65442	4.3011	2325.00	0.00	0.0000
5.1282	1950.00	0.26	0.26145	4.6729	2140.00	0.70	0.70262	4.2918	2330.00	0.00	0.0000
5.1151	1955.00	0.30	0.29544	4.6620	2145.00	0.73	0.72944	4.2827	2335.00	0.00	0.0000
5.1020	1960.00	0.35	0.35316	4.6512	2150.00	0.74	0.73580	4.2735	2340.00	0.00	0.0000
5.0891	1965.00	0.43	0.42898	4.6404	2155.00	0.72	0.71847	4.2644	2345.00	0.00	0.0000
5.0761	1970.00	0.53	0.53461	4.6296	2160.00	0.69	0.68709	4.2553	2350.00	0.00	0.0000
5.0633	1975.00	0.58	0.57723	4.6189	2165.00	0.66	0.65849	4.2463	2355.00	0.00	0.0000
5.0505	1980.00	0.57	0.57215	4.6083	2170.00	0.61	0.61308	4.2373	2360.00	0.00	0.0000
5.0378	1985.00	0.52	0.52452	4.5977	2175.00	0.55	0.55195	4.2283	2365.00	0.00	0.0000
5.0251	1990.00	0.45	0.45236	4.5872	2180.00	0.48	0.48124	4.2194	2370.00	0.00	0.0000
5.0125	1995.00	0.45	0.45156	4.5767	2185.00	0.39	0.38987	4.2105	2375.00	0.01	0.0079
5.0000	2000.00	0.47	0.47095	4.5662	2190.00	0.30	0.30443	4.2017	2380.00	0.04	0.0430
4.9875	2005.00	0.50	0.49745	4.5558	2195.00	0.23	0.23146	4.1929	2385.00	0.11	0.1101
4.9751	2010.00	0.49	0.48717	4.5455	2200.00	0.17	0.17270	4.1841	2390.00	0.21	0.2112
4.9628	2015.00	0.48	0.47563	4.5351	2205.00	0.13	0.13269	4.1754	2395.00	0.33	0.3321
4.9505	2020.00	0.50	0.50067	4.5249	2210.00	0.11	0.10967	4.1667	2400.00	0.44	0.4354
4.9383	2025.00	0.53	0.53263	4.5147	2215.00	0.10	0.09711	4.1580	2405.00	0.51	0.5122
4.9261	2030.00	0.60	0.59560	4.5045	2220.00	0.09	0.08853	4.1494	2410.00	0.56	0.5605
4.9140	2035.00	0.62	0.61727	4.4944	2225.00	0.08	0.08043	4.1408	2415.00	0.59	0.5858
4.9020	2040.00	0.60	0.59815	4.4843	2230.00	0.06	0.06255	4.1322	2420.00	0.61	0.6054
4.8900	2045.00	0.59	0.59040	4.4743	2235.00	0.04	0.04376	4.1237	2425.00	0.62	0.6232
4.8780	2050.00	0.56	0.55842	4.4643	2240.00	0.03	0.02833	4.1152	2430.00	0.64	0.6380

4.8662	2055.00	0.54	0.53882	4.4543	2245.00	0.02	0.01610	4.1068	2435.00	0.65	0.6505
4.8544	2060.00	0.50	0.49921	4.4444	2250.00	0.01	0.01039	4.0984	2440.00	0.66	0.6619
4.8426	2065.00	0.44	0.44239	4.4346	2255.00	0.01	0.00689	4.0900	2445.00	0.67	0.6747
4.8309	2070.00	0.43	0.42694	4.4248	2260.00	0.00	0.00379	4.0816	2450.00	0.69	0.6899
4.8193	2075.00	0.40	0.39911	4.4150	2265.00	0.00	0.00166	4.0733	2455.00	0.71	0.7071
4.8077	2080.00	0.41	0.41448	4.4053	2270.00	0.00	0.00073	4.0650	2460.00	0.72	0.7241
4.7962	2085.00	0.46	0.45637	4.3956	2275.00	0.00	0.00018	4.0568	2465.00	0.74	0.7381
4.7847	2090.00	0.47	0.47231	4.3860	2280.00	0.00	0.00008	4.0486	2470.00	0.75	0.7510
4.7733	2095.00	0.52	0.51928	4.3764	2285.00	0.00	0.00004	4.0404	2475.00	0.76	0.7646
4.7619	2100.00	0.55	0.54816	4.3668	2290.00	0.00	0.00002	4.0323	2480.00	0.78	0.7801
4.7506	2105.00	0.55	0.55170	4.3573	2295.00	0.00	0.00001				

1 SMOD - TRIANG SLIT - 20CM-1

VARIABLE SLIT FUNCTION
WIDTH= 40.00000 SHIFT= 5.00000 NO. OF DEFINING PTS= 3
YS ARE 0.000 1.000 0.000
XS ARE -1.000 0.000 1.000

1 RADIATION (WATTS/SR/CM**2/UNITS)

V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM	V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM	V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM
1920.00	1.9722E-07	5.2083	7.270E-05	2110.00	1.2304E-07	4.7393	5.478E-05	2300.00	5.4209E-09	4.3478	2.868E-06
1925.00	2.0565E-07	5.1948	7.620E-05	2115.00	1.1853E-07	4.7281	5.302E-05	2305.00	5.1778E-09	4.3384	2.751E-06
1930.00	2.1498E-07	5.1813	8.008E-05	2120.00	1.1546E-07	4.7170	5.189E-05	2310.00	5.2415E-09	4.3290	2.797E-06
1935.00	2.1542E-07	5.1680	8.066E-05	2125.00	1.1663E-07	4.7059	5.266E-05	2315.00	5.4904E-09	4.3197	2.942E-06
1940.00	2.1745E-07	5.1546	8.184E-05	2130.00	1.2135E-07	4.6948	5.505E-05	2320.00	5.7878E-09	4.3103	3.115E-06
1945.00	2.1204E-07	5.1414	8.021E-05	2135.00	1.2814E-07	4.6838	5.841E-05	2325.00	6.1524E-09	4.3011	3.326E-06
1950.00	2.1301E-07	5.1282	8.100E-05	2140.00	1.3354E-07	4.6729	6.116E-05	2330.00	6.3998E-09	4.2918	3.474E-06
1955.00	2.1630E-07	5.1151	8.267E-05	2145.00	1.3507E-07	4.6620	6.214E-05	2335.00	6.4220E-09	4.2827	3.501E-06
1960.00	2.2248E-07	5.1020	8.547E-05	2150.00	1.3306E-07	4.6512	6.151E-05	2340.00	6.4152E-09	4.2735	3.513E-06
1965.00	2.3127E-07	5.0891	8.930E-05	2155.00	1.2827E-07	4.6404	5.957E-05	2345.00	6.2769E-09	4.2644	3.452E-06
1970.00	2.4267E-07	5.0761	9.418E-05	2160.00	1.2223E-07	4.6296	5.703E-05	2350.00	6.1226E-09	4.2553	3.381E-06
1975.00	2.4393E-07	5.0633	9.515E-05	2165.00	1.1679E-07	4.6189	5.474E-05	2355.00	6.0380E-09	4.2463	3.349E-06
1980.00	2.3829E-07	5.0505	9.342E-05	2170.00	1.1003E-07	4.6083	5.181E-05	2360.00	5.7443E-09	4.2373	3.199E-06
1985.00	2.2683E-07	5.0378	8.937E-05	2175.00	1.0170E-07	4.5977	4.811E-05	2365.00	5.3153E-09	4.2283	2.973E-06
1990.00	2.0974E-07	5.0251	8.306E-05	2180.00	9.2179E-08	4.5872	4.381E-05	2370.00	4.9254E-09	4.2194	2.767E-06
1995.00	2.0654E-07	5.0125	8.220E-05	2185.00	8.0592E-08	4.5767	3.848E-05	2375.00	5.9007E-09	4.2105	3.328E-06
2000.00	2.0609E-07	5.0000	8.243E-05	2190.00	6.9240E-08	4.5662	3.321E-05	2380.00	9.3268E-09	4.2017	5.283E-06
2005.00	2.0689E-07	4.9875	8.317E-05	2195.00	5.9121E-08	4.5558	2.848E-05	2385.00	1.5369E-08	4.1929	8.742E-06
2010.00	2.0389E-07	4.9751	8.238E-05	2200.00	5.0524E-08	4.5455	2.445E-05	2390.00	2.3656E-08	4.1841	1.351E-05
2015.00	1.9793E-07	4.9628	8.037E-05	2205.00	4.4133E-08	4.5351	2.146E-05	2395.00	3.1621E-08	4.1754	1.814E-05
2020.00	1.9672E-07	4.9505	8.027E-05	2210.00	4.0098E-08	4.5249	1.958E-05	2400.00	3.7440E-08	4.1667	2.157E-05
2025.00	1.9630E-07	4.9383	8.050E-05	2215.00	3.7509E-08	4.5147	1.840E-05	2405.00	4.0814E-08	4.1580	2.361E-05
2030.00	1.9918E-07	4.9261	8.208E-05	2220.00	3.5335E-08	4.5045	1.741E-05	2410.00	4.1894E-08	4.1494	2.433E-05
2035.00	1.9704E-07	4.9140	8.160E-05	2225.00	3.3229E-08	4.4944	1.645E-05	2415.00	4.1898E-08	4.1408	2.444E-05
2040.00	1.8919E-07	4.9020	7.873E-05	2230.00	2.9765E-08	4.4843	1.480E-05	2420.00	4.1693E-08	4.1322	2.442E-05
2045.00	1.8219E-07	4.8900	7.619E-05	2235.00	2.5961E-08	4.4743	1.297E-05	2425.00	4.1385E-08	4.1237	2.434E-05
2050.00	1.7226E-07	4.8780	7.239E-05	2240.00	2.2564E-08	4.4643	1.132E-05	2430.00	4.0971E-08	4.1152	2.419E-05
2055.00	1.6422E-07	4.8662	6.935E-05	2245.00	1.9216E-08	4.4543	9.685E-06	2435.00	4.0465E-08	4.1068	2.399E-05
2060.00	1.5367E-07	4.8544	6.521E-05	2250.00	1.6364E-08	4.4444	8.284E-06	2440.00	3.9917E-08	4.0984	2.376E-05
2065.00	1.4118E-07	4.8426	6.020E-05	2255.00	1.3785E-08	4.4346	7.010E-06	2445.00	3.9429E-08	4.0900	2.357E-05
2070.00	1.3393E-07	4.8309	5.739E-05	2260.00	1.1140E-08	4.4248	5.690E-06	2450.00	3.9023E-08	4.0816	2.342E-05
2075.00	1.2591E-07	4.8193	5.421E-05	2265.00	9.1801E-09	4.4150	4.710E-06	2455.00	3.8689E-08	4.0733	2.332E-05

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2080.00  1.2465E-07   4.8077  5.393E-05    2270.00  8.0511E-09   4.4053  4.149E-06    2460.00  3.8362E-08   4.0650  2.322E-05
2085.00  1.2729E-07   4.7962  5.534E-05    2275.00  7.3820E-09   4.3956  3.821E-06    2465.00  3.7936E-08   4.0568  2.305E-05
2090.00  1.2688E-07   4.7847  5.542E-05    2280.00  7.1699E-09   4.3860  3.727E-06    2470.00  3.7475E-08   4.0486  2.286E-05
2095.00  1.2923E-07   4.7733  5.672E-05    2285.00  6.8766E-09   4.3764  3.590E-06    2475.00  3.7038E-08   4.0404  2.269E-05
2100.00  1.2940E-07   4.7619  5.707E-05    2290.00  6.3682E-09   4.3668  3.340E-06    2480.00  3.6668E-08   4.0323  2.255E-05
2105.00  1.2613E-07   4.7506  5.589E-05    2295.00  5.8510E-09   4.3573  3.082E-06
 4
1 PROGRAM WILL BE EXECUTED IN THE EMISSION MODE
  3  1  2  0  1  0  0  0  0  0  1      0.000    275.000  0  0       0.000 0


          SLANT PATH BETWEEN ALTITUDES H1 AND H2 WHERE H1 =100.000 KM H2 =  0.000 KM,ZENITH ANGLE =180.000 DEGREES

                    HAZE MODEL  = 23.0 KM VISUAL RANGE AT SEA LEVEL

                MODEL ATMOSPHERE 3 = MIDLATITUDE WINTER

                  HAZE MODEL  1 =      RURAL    VIS= 23.0KM

                SEASON =      FAL WINT

                VERTICAL PROFILE AEROSOL MODEL =          STR BKGR

          FREQUENCY RANGE V1=  1900.0 CM-1 TO V2=  2500.0 CM-1 FOR DV =   5.0 CM-1   (  4.00 -  5.26 MICRONS )

 FROM POINT\ HEIGHT=  100.0000 KM,N= 33,NP= 1,REF. INDEX ABOVE & BELOW X= 0.0000E 00 0.0000E 00,IP=  1
           EQUIV. ABSORBER AMOUNTS PER KM AT X= 0.150E-15 0.539E-11 0.517E-11 0.104E-12 0.604E-19 0.385E-06 0.000E 00 0.201E-08


     TX(12-14)= 0.000E 00 0.000E 00 0.931E-09

 FROM POINT\ HEIGHT=    0.0000 KM,N=  1,NP= 1,REF. INDEX ABOVE & BELOW X= 0.2739E-03 0.0000E 00,IP=  1
           EQUIV. ABSORBER AMOUNTS PER KM AT X= 0.352E 00 0.101E 01 0.281E-02 0.812E 00 0.329E-02 0.101E 01 0.158E 00 0.280E-02


     TX(12-14)= 0.000E 00 0.000E 00 0.000E 00
 HMIN =  -6371.223
 -6371.223

          EQUIVALENT SEA LEVEL ABSORBER AMOUNTS

                    WATER VAPOUR      CO2 ETC.        OZONE     NITROGEN (CONT)  H2O  (CONT)     MOL  SCAT      AER1        OZONE(U-V
                      GM CM-2           KM          ATM CM          KM           GM CM-2          KM                        ATM CM
                                                                                                                          NITRIC ACID

          W(1-8)=     0.701E 00     0.474E 01     0.137E 00     0.334E 01     0.530E-02     0.804E 01     0.205E 00     0.397E 00
                                                                                0.141E 00                                 0.374E-03

                          AER2          AER3          AER4      R.H. MEAN
          W(12-15)=    3.648E-02     7.922E-03     1.181E-04     7.168E 01
  ICN      1    6   10   15
  EXTINCTION AND ABSORPTION COEFFICIENTS
 1                                                    RADIANCE(WATTS/CM2-STER-XXX)
                          FR(CM-1)  WVL(MICRON)     PER CM-1    PER MICRON      INTEGRAL         TRANS
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INTEGRATED ABSORPTION FROM 1900 TO 2500 CM-1 = 378.08AVERAGE TRANSMITTANCE =0.3685
INTEGRATED RADIANCE = 0.56216E-04WATT CM -2 SR
RADMIN 2375.000 0.32925E-08
RADMAX 1900.000 0.22295E-06

LOWS - NADIR VEWING - GRND TO SPACE

NO SLIT FUNCTION USED

ATMOSPHERIC TRANSMITTANCE

LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE	
5.2632	1900.00	0.15	0.15296	4.7506	2105.00	0.62	0.61916	4.3290	2310.00	0.00	0.0000
5.2493	1905.00	0.14	0.13713	4.7393	2110.00	0.63	0.63489	4.3197	2315.00	0.00	0.0000
5.2356	1910.00	0.12	0.11676	4.7281	2115.00	0.62	0.61545	4.3103	2320.00	0.00	0.0000
5.2219	1915.00	0.11	0.10758	4.7170	2120.00	0.62	0.61698	4.3011	2325.00	0.00	0.0000
5.2083	1920.00	0.10	0.10491	4.7059	2125.00	0.63	0.63250	4.2918	2330.00	0.00	0.0000
5.1948	1925.00	0.14	0.13873	4.6948	2130.00	0.67	0.66890	4.2827	2335.00	0.00	0.0000
5.1813	1930.00	0.18	0.17728	4.6838	2135.00	0.72	0.71772	4.2735	2340.00	0.00	0.0000
5.1680	1935.00	0.20	0.19524	4.6729	2140.00	0.72	0.72089	4.2644	2345.00	0.00	0.0000
5.1546	1940.00	0.19	0.19428	4.6620	2145.00	0.73	0.73488	4.2553	2350.00	0.00	0.0000
5.1414	1945.00	0.18	0.18430	4.6512	2150.00	0.74	0.73621	4.2463	2355.00	0.00	0.0000
5.1282	1950.00	0.22	0.21719	4.6404	2155.00	0.73	0.73412	4.2373	2360.00	0.00	0.0000
5.1151	1955.00	0.25	0.24856	4.6296	2160.00	0.73	0.72608	4.2283	2365.00	0.00	0.0000
5.1020	1960.00	0.30	0.29829	4.6189	2165.00	0.71	0.71280	4.2194	2370.00	0.00	0.0000
5.0891	1965.00	0.35	0.35370	4.6083	2170.00	0.67	0.67176	4.2105	2375.00	0.00	0.0000
5.0761	1970.00	0.40	0.39940	4.5977	2175.00	0.63	0.62612	4.2017	2380.00	0.00	0.0016
5.0633	1975.00	0.43	0.42646	4.5872	2180.00	0.53	0.52801	4.1929	2385.00	0.03	0.0296
5.0505	1980.00	0.41	0.41421	4.5767	2185.00	0.44	0.44461	4.1841	2390.00	0.11	0.1136
5.0378	1985.00	0.38	0.37777	4.5662	2190.00	0.38	0.37919	4.1754	2395.00	0.26	0.2560
5.0251	1990.00	0.33	0.32860	4.5558	2195.00	0.31	0.30507	4.1667	2400.00	0.45	0.4500
5.0125	1995.00	0.34	0.34255	4.5455	2200.00	0.26	0.25614	4.1580	2405.00	0.58	0.5802
5.0000	2000.00	0.40	0.39742	4.5351	2205.00	0.23	0.22723	4.1494	2410.00	0.65	0.6523
4.9875	2005.00	0.44	0.43597	4.5249	2210.00	0.19	0.19103	4.1408	2415.00	0.66	0.6629
4.9751	2010.00	0.47	0.46960	4.5147	2215.00	0.18	0.17958	4.1322	2420.00	0.67	0.6730
4.9628	2015.00	0.45	0.44623	4.5045	2220.00	0.15	0.15111	4.1237	2425.00	0.68	0.6774
4.9505	2020.00	0.44	0.43639	4.4944	2225.00	0.12	0.11927	4.1152	2430.00	0.68	0.6826
4.9383	2025.00	0.47	0.47085	4.4843	2230.00	0.09	0.09010	4.1068	2435.00	0.69	0.6896
4.9261	2030.00	0.52	0.51506	4.4743	2235.00	0.05	0.05435	4.0984	2440.00	0.69	0.6949
4.9140	2035.00	0.55	0.55334	4.4643	2240.00	0.03	0.03016	4.0900	2445.00	0.70	0.7038
4.9020	2040.00	0.57	0.56533	4.4543	2245.00	0.01	0.01262	4.0816	2450.00	0.72	0.7161
4.8900	2045.00	0.56	0.55736	4.4444	2250.00	0.01	0.00656	4.0733	2455.00	0.73	0.7334
4.8780	2050.00	0.54	0.53504	4.4346	2255.00	0.00	0.00369	4.0650	2460.00	0.75	0.7496
4.8662	2055.00	0.52	0.52365	4.4248	2260.00	0.00	0.00150	4.0568	2465.00	0.76	0.7603
4.8544	2060.00	0.51	0.50878	4.4150	2265.00	0.00	0.00073	4.0486	2470.00	0.77	0.7742
4.8426	2065.00	0.49	0.49430	4.4053	2270.00	0.00	0.00000	4.0404	2475.00	0.79	0.7875
4.8309	2070.00	0.52	0.52199	4.3956	2275.00	0.00	0.00000	4.0323	2480.00	0.80	0.8012
4.8193	2075.00	0.55	0.55268	4.3860	2280.00	0.00	0.00000	4.0241	2485.00	0.82	0.8189
4.8077	2080.00	0.61	0.60956	4.3764	2285.00	0.00	0.00000	4.0161	2490.00	0.83	0.8323
4.7962	2085.00	0.64	0.63594	4.3668	2290.00	0.00	0.00000	4.0080	2495.00	0.85	0.8457
4.7847	2090.00	0.64	0.64072	4.3573	2295.00	0.00	0.00000	4.0000	2500.00	0.86	0.8615
4.7733	2095.00	0.63	0.63072	4.3478	2300.00	0.00	0.00000				

4.7619	2100.00	0.62	0.61660	4.3384	2305.00	0.00	0.00000

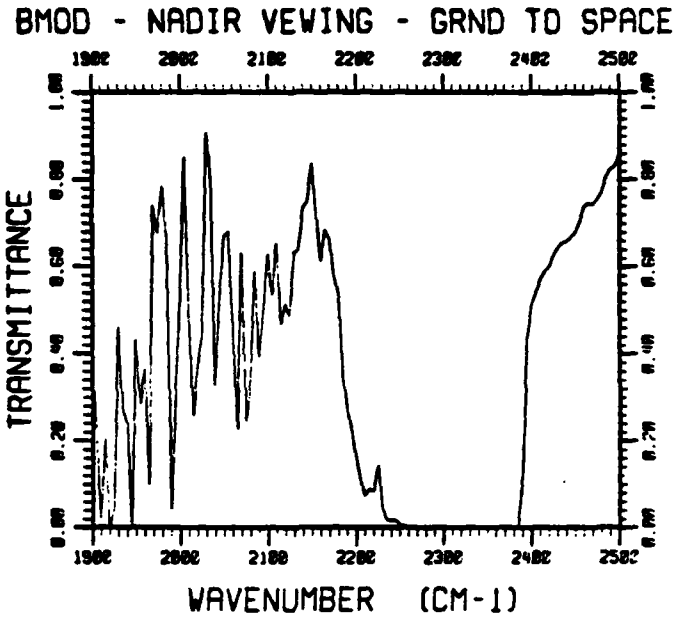
LOWS - NADIR VIEWING - GRND TO SPACE

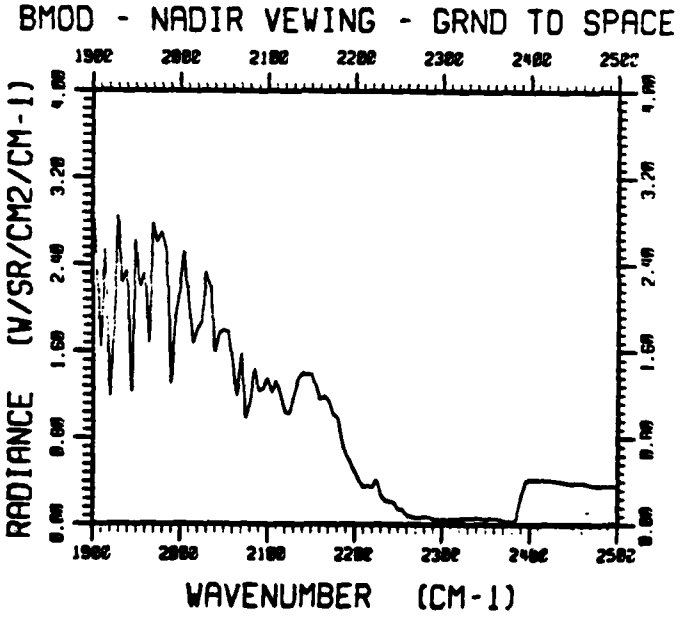
NO SLIT FUNCTION USED

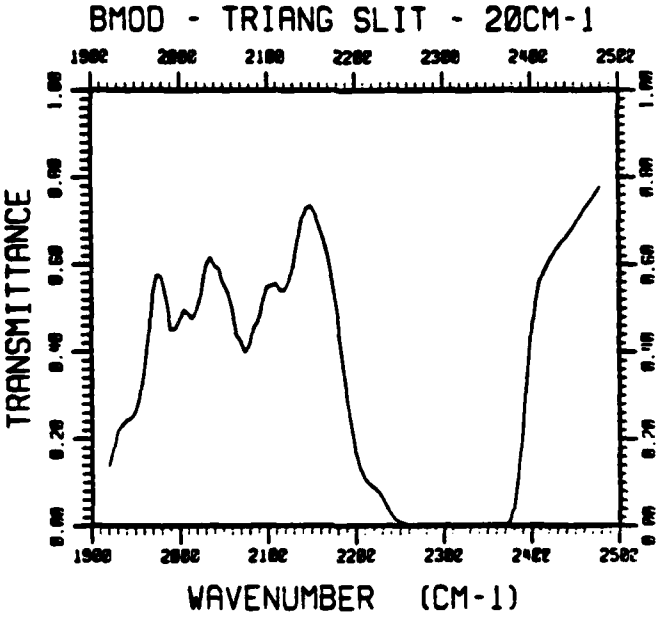
RADIATION (WATTS/SR/CM**2/UNITS)

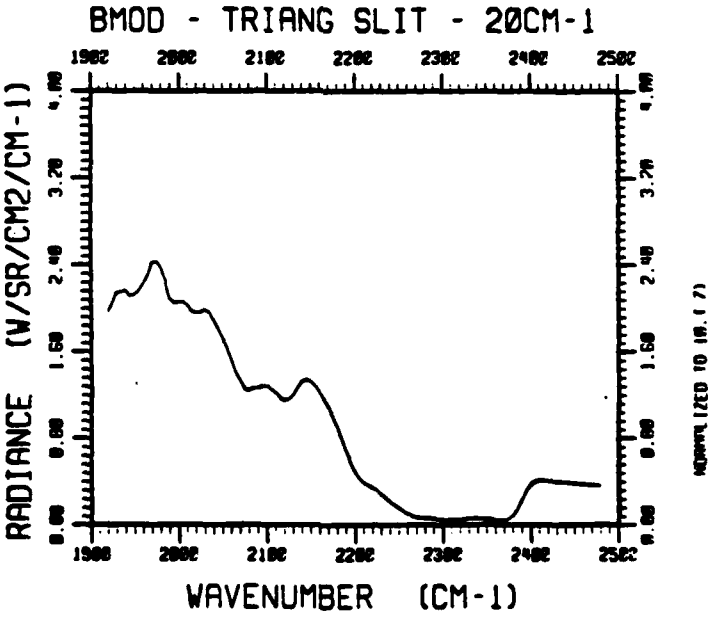
V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM	V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM	V CM-1	RADIATION PER CM-1	LAMBDA MICRONS	RADIATION PER UM
1900.00	2.2295E-07	5.2632	8.0488E-05	2105.00	1.3616E-07	4.7506	6.0338E-05	2310.00	6.0714E-09	4.3290	3.240E-06
1905.00	2.1264E-07	5.2493	7.7178E-05	2110.00	1.3498E-07	4.7393	6.010E-05	2315.00	6.6812E-09	4.3197	3.581E-06
1910.00	2.0094E-07	5.2356	7.3318E-05	2115.00	1.2773E-07	4.7281	5.714E-05	2320.00	7.4851E-09	4.3103	4.029E-06
1915.00	1.9357E-07	5.2219	7.099E-05	2120.00	1.2667E-07	4.7170	5.693E-05	2325.00	8.3502E-09	4.3011	4.514E-06
1920.00	1.8886E-07	5.2083	6.962E-05	2125.00	1.2746E-07	4.7059	5.755E-05	2330.00	8.7404E-09	4.2918	4.745E-06
1925.00	1.9655E-07	5.1948	7.284E-05	2130.00	1.3206E-07	4.6948	5.992E-05	2335.00	8.6612E-09	4.2827	4.722E-06
1930.00	2.0404E-07	5.1813	7.600E-05	2135.00	1.3853E-07	4.6838	6.314E-05	2340.00	8.0053E-09	4.2735	4.383E-06
1935.00	2.0541E-07	5.1680	7.691E-05	2140.00	1.3723E-07	4.6729	6.284E-05	2345.00	7.7103E-09	4.2644	4.240E-06
1940.00	2.0184E-07	5.1546	7.597E-05	2145.00	1.3651E-07	4.6620	6.281E-05	2350.00	8.0162E-09	4.2553	4.427E-06
1945.00	1.9598E-07	5.1414	7.414E-05	2150.00	1.3386E-07	4.6512	6.188E-05	2355.00	8.1769E-09	4.2463	4.535E-06
1950.00	2.0058E-07	5.1282	7.627E-05	2155.00	1.3049E-07	4.6404	6.060E-05	2360.00	8.0439E-09	4.2373	4.480E-06
1955.00	2.0387E-07	5.1151	7.792E-05	2160.00	1.2639E-07	4.6296	5.897E-05	2365.00	6.3846E-09	4.2283	3.571E-06
1960.00	2.1031E-07	5.1020	8.079E-05	2165.00	1.2140E-07	4.6189	5.690E-05	2370.00	3.6378E-09	4.2194	2.043E-06
1965.00	2.1621E-07	5.0891	8.348E-05	2170.00	1.1456E-07	4.6083	5.395E-05	2375.00	3.2925E-09	4.2105	1.857E-06
1970.00	2.2047E-07	5.0761	8.556E-05	2175.00	1.0748E-07	4.5977	5.085E-05	2380.00	4.5624E-09	4.2017	2.584E-06
1975.00	2.2078E-07	5.0633	8.612E-05	2180.00	9.5297E-08	4.5872	4.529E-05	2385.00	9.7345E-09	4.1929	5.537E-06
1980.00	2.1475E-07	5.0505	8.419E-05	2185.00	8.4509E-08	4.5767	4.035E-05	2390.00	1.7155E-08	4.1841	9.913E-06
1985.00	2.0448E-07	5.0378	8.057E-05	2190.00	7.5308E-08	4.5662	3.612E-05	2395.00	2.6795E-08	4.1754	1.537E-05
1990.00	1.9261E-07	5.0251	7.628E-05	2195.00	6.4454E-08	4.5558	3.105E-05	2400.00	3.7162E-08	4.1667	2.141E-05
1995.00	1.9112E-07	5.0125	7.607E-05	2200.00	5.7493E-08	4.5455	2.783E-05	2405.00	4.2571E-08	4.1580	2.462E-05
2000.00	1.9631E-07	5.0000	7.852E-05	2205.00	5.2866E-08	4.5351	2.570E-05	2410.00	4.4891E-08	4.1494	2.607E-05
2005.00	1.9826E-07	4.9875	7.970E-05	2210.00	4.7162E-08	4.5249	2.303E-05	2415.00	4.4359E-08	4.1408	2.587E-05
2010.00	1.9921E-07	4.9751	8.048E-05	2215.00	4.4786E-08	4.5147	2.197E-05	2420.00	4.3774E-08	4.1322	2.564E-05
2015.00	1.9223E-07	4.9628	7.805E-05	2220.00	4.0019E-08	4.5045	1.972E-05	2425.00	4.3015E-08	4.1237	2.530E-05
2020.00	1.8696E-07	4.9505	7.629E-05	2225.00	3.4689E-08	4.4944	1.717E-05	2430.00	4.2262E-08	4.1152	2.496E-05
2025.00	1.8769E-07	4.9383	7.696E-05	2230.00	2.9658E-08	4.4843	1.479E-05	2435.00	4.1570E-08	4.1068	2.465E-05
2030.00	1.8909E-07	4.9261	7.792E-05	2235.00	2.3355E-08	4.4743	1.167E-05	2440.00	4.0848E-08	4.0984	2.432E-05
2035.00	1.8892E-07	4.9140	7.824E-05	2240.00	1.8456E-08	4.4643	9.260E-06	2445.00	4.0266E-08	4.0900	2.407E-05
2040.00	1.8515E-07	4.9020	7.705E-05	2245.00	1.3576E-08	4.4543	6.843E-06	2450.00	3.9782E-08	4.0816	2.388E-05
2045.00	1.7854E-07	4.8900	7.467E-05	2250.00	1.1149E-08	4.4444	5.644E-06	2455.00	3.9451E-08	4.0733	2.378E-05
2050.00	1.7017E-07	4.8780	7.151E-05	2255.00	9.6541E-09	4.4346	4.909E-06	2460.00	3.9093E-08	4.0650	2.366E-05
2055.00	1.6462E-07	4.8662	6.952E-05	2260.00	8.0138E-09	4.4248	4.093E-06	2465.00	3.8579E-08	4.0568	2.344E-05
2060.00	1.5929E-07	4.8544	6.760E-05	2265.00	7.1347E-09	4.4150	3.660E-06	2470.00	3.8125E-08	4.0486	2.326E-05
2065.00	1.5387E-07	4.8426	6.561E-05	2270.00	6.4927E-09	4.4053	3.346E-06	2475.00	3.7674E-08	4.0404	2.308E-05
2070.00	1.5270E-07	4.8309	6.543E-05	2275.00	5.9450E-09	4.3956	3.077E-06	2480.00	3.7238E-08	4.0323	2.290E-05
2075.00	1.5164E-07	4.8193	6.529E-05	2280.00	5.4972E-09	4.3860	2.858E-06	2485.00	3.6924E-08	4.0241	2.280E-05
2080.00	1.5229E-07	4.8077	6.589E-05	2285.00	5.2089E-09	4.3764	2.720E-06	2490.00	3.6518E-08	4.0161	2.264E-05
2085.00	1.5115E-07	4.7962	6.571E-05	2290.00	5.1192E-09	4.3668	2.685E-06	2495.00	3.6109E-08	4.0080	2.248E-05
2090.00	1.4750E-07	4.7847	6.443E-05	2295.00	5.1696E-09	4.3573	2.723E-06	2500.00	3.5733E-08	4.0000	2.233E-05
2095.00	1.4276E-07	4.7733	6.266E-05	2300.00	5.3934E-09	4.3478	2.853E-06				
2100.00	1.3893E-07	4.7619	6.127E-05	2305.00	5.7638E-09	4.3384	3.062E-06				

0


BMOD - NADIR VEWING - GRND TO SPACE
TRANSMITTANCE
WAVENUMBER (CM-1)


BMOD - NADIR VEWING - GRND TO SPACE
RADIANCE (W/SR/CM2/CM-1)
WAVENUMBER (CM-1)


BMOD - TRIANG SLIT - 20CM-1
TRANSMITTANCE
WAVENUMBER (CM-1)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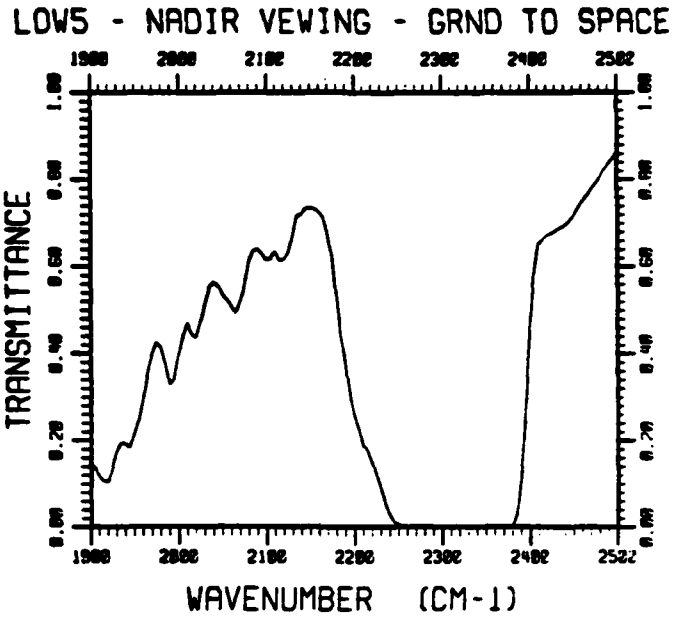
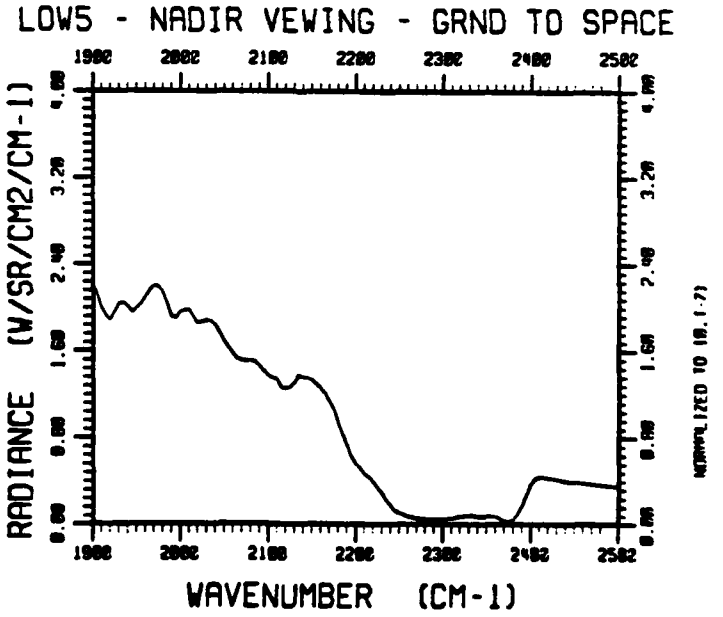
RADIANCE (W/SR/CM2/CM-1)
WAVENUMBER (CM-1)


LOW5 - NADIR VEWING - GRND TO SPACE
TRANSMITTANCE
WAVENUMBER (CM-1)


LOW5 - NADIR VEWING - GRND TO SPACE
RADIANCE (W/SR/CM2/CM-1)
WAVENUMBER (CM-1)

```
  3  1  2  0  1                  0                275.                  13
      100.          0.        180.          0.0
      400.       9995.          5.
  4
BH00 - GND TO SPACE (NADIR VIEWING) - 5 CM-1 RES.
 1 1  1
     9.595
       5.
 10
  0
BH00 - SLIT FCN - 20CM-1
 2 1 1 3          40.          5.
       -1.          0.          1.
        0.          1.          0.
     9.595
       5.
  3  1  2  0  1                  0                275.                  0J
      100.          0.        180.          0.0
     1900.       2500.          5.
  0
LOWS - NADIR VIEWING - GRND TO SPACE
 1 1  1
       5.       1900.       2500.        100.          9
       6.        0.0          1.          .2          9
```

```
1 PROGRAM WILL BE EXECUTED IN THE TRANSMISSION MODE
 THE SCN-1 BAND MODEL OPTION WILL BE USED
  3  1  2  0  1  0  0  0  0  0  0     0.000   275.000  0  0      0.000 1
           100.000     0.000   180.000     0.000     0.000
         H1=100.000KM,H2=  0.000KM,ANGLE=180.0000DEGM. RANGE = 100.00KM,BETA=-0.00000
   400.000  9995.000     5.000


         SLANT PATH BETWEEN ALTITUDES H1 AND H2 WHERE H1 =100.000 KM H2 =  0.000 KM,ZENITH ANGLE =180.000 DEGREES

                  HAZE MODEL  = 23.0 KM VISUAL RANGE AT SEA LEVEL

                MODEL ATMOSPHERE 3 = MIDLATITUDE WINTER

                  HAZE MODEL  1 =      RURAL    VIS= 23.0KM

                SEASON =      FAL WINT

                VERTICAL PROFILE AEROSOL MODEL =         STR BNDR

         FREQUENCY RANGE V1=   400.0 CM-1 TO V2=  9995.0 CM-1 FOR DV =   5.0 CM-1   (  1.00 - 25.00 MICRONS )

FROM POINT\ HEIGHT=  100.0000 KM,M=  33,MP=  1,REF. INDEX ABOVE & BELOW X= 0.0000E 00 0.0000E 00,IP=  1
          EQUIV. ABSORBER AMOUNTS PER KM AT X= 0.100E-09 0.385E-06 0.201E-08 0.104E-12 0.604E-19 0.385E-06 0.000E 00 0.201E-08


    TX(12-14)= 0.000E 00 0.000E 00 0.931E-09

FROM POINT\ HEIGHT=    0.0000 KM,M=  1,MP=  1,REF. INDEX ABOVE & BELOW X= 0.2744E-03 0.0000E 00,IP=  1
          EQUIV. ABSORBER AMOUNTS PER KM AT X= 0.350E 00 0.101E 01 0.280E-02 0.812E 00 0.329E-02 0.101E 01 0.150E 00 0.280E-02


    TX(12-14)= 0.000E 00 0.000E 00 0.000E 00
HMIN =  -6371.223
-6371.223

         EQUIVALENT SEA LEVEL ABSORBER AMOUNTS

                  WATER VAPOUR     CO2 ETC.       OZONE     NITROGEN (CONT)  H2O  (CONT)     MOL  SCAT      AER1        OZONE(U-V
                    GM CM-2          KM          ATM CM          KM          GM CM-2          KM                          ATM CM
                                                                                                                      NITRIC ACID
         W(1-8)=     0.853E 00     0.804E 01     0.397E 00     0.334E 01     0.530E-02     0.804E 01     0.205E 00     0.397E 00
                                                                               0.141E 00                                 0.374E-03

                          AER2          AER3          AER4     R.H. MEAN
         W(12-15)=     3.648E-02     7.921E-03     1.181E-04     7.168E 01
 ICH      1   6   10   15
 EXTINCTION AND ABSORPTION COEFFICIENTS
INTEGRATED ABSORPTION FROM  400 TO 9995 CM-1 =   4239.74AVERAGE TRANSMITTANCE =0.5581
1                          BMOD - GND TO SPACE (NADIR VIEWING) - 5 CM-1 RES.


NO SLIT FUNCTION USED
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ATMOSPHERIC TRANSMITTANCE

LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE	
25.0000	400.00	0.00	0.00002	14.2857	700.00	0.00	0.00068	10.0000	1000.00	0.75	0.7483
24.6914	405.00	0.18	0.17666	14.1844	705.00	0.00	0.00163	9.9502	1005.00	0.64	0.6352
24.3902	410.00	0.37	0.36630	14.0845	710.00	0.02	0.01969	9.9010	1010.00	0.49	0.4945
24.0964	415.00	0.04	0.03641	13.9860	715.00	0.04	0.04280	9.8522	1015.00	0.37	0.3703
23.8095	420.00	0.00	0.00000	13.8889	720.00	0.00	0.00003	9.8039	1020.00	0.26	0.2586
23.5294	425.00	0.00	0.00080	13.7931	725.00	0.14	0.13579	9.7561	1025.00	0.23	0.2264
23.2558	430.00	0.06	0.05972	13.6986	730.00	0.10	0.10392	9.7087	1030.00	0.22	0.2188
22.9885	435.00	0.06	0.05895	13.6054	735.00	0.15	0.14695	9.6618	1035.00	0.18	0.1821
22.7273	440.00	0.01	0.01430	13.5135	740.00	0.02	0.02104	9.6154	1040.00	0.14	0.1433
22.4719	445.00	0.03	0.03116	13.4228	745.00	0.27	0.26940	9.5694	1045.00	0.44	0.4416
22.2222	450.00	0.27	0.26679	13.3333	750.00	0.32	0.32364	9.5238	1050.00	0.14	0.1380
21.9780	455.00	0.02	0.01670	13.2450	755.00	0.32	0.31622	9.4787	1055.00	0.13	0.1341
21.7391	460.00	0.00	0.00018	13.1579	760.00	0.64	0.64018	9.4340	1060.00	0.20	0.2004
21.5054	465.00	0.18	0.18425	13.0719	765.00	0.74	0.74392	9.3897	1065.00	0.45	0.4542
21.2766	470.00	0.01	0.00896	12.9870	770.00	0.73	0.73210	9.3458	1070.00	0.82	0.8186
21.0526	475.00	0.02	0.01936	12.9032	775.00	0.70	0.69584	9.3023	1075.00	0.81	0.8133
20.8333	480.00	0.34	0.34322	12.8205	780.00	0.81	0.81271	9.2593	1080.00	0.86	0.8597
20.6186	485.00	0.05	0.04852	12.7389	785.00	0.74	0.74486	9.2166	1085.00	0.88	0.8816
20.4082	490.00	0.12	0.11901	12.6582	790.00	0.70	0.69821	9.1743	1090.00	0.86	0.8610
20.2020	495.00	0.56	0.55700	12.5786	795.00	0.70	0.69783	9.1324	1095.00	0.91	0.9097
20.0000	500.00	0.07	0.07122	12.5000	800.00	0.68	0.68347	9.0909	1100.00	0.83	0.8342
19.8020	505.00	0.09	0.09117	12.4224	805.00	0.77	0.77182	9.0498	1105.00	0.84	0.8350
19.6078	510.00	0.27	0.27113	12.3457	810.00	0.82	0.82155	9.0090	1110.00	0.84	0.8375
19.4175	515.00	0.11	0.11032	12.2699	815.00	0.81	0.81336	8.9686	1115.00	0.91	0.9057
19.2308	520.00	0.07	0.06821	12.1951	820.00	0.91	0.91181	8.9286	1120.00	0.79	0.7934
19.0476	525.00	0.12	0.11908	12.1212	825.00	0.88	0.88311	8.8889	1125.00	0.89	0.8917
18.8679	530.00	0.69	0.68634	12.0482	830.00	0.87	0.87004	8.8496	1130.00	0.90	0.8992
18.6916	535.00	0.32	0.31714	11.9760	835.00	0.92	0.91762	8.8106	1135.00	0.67	0.6683
18.5185	540.00	0.50	0.49609	11.9048	840.00	0.85	0.85231	8.7719	1140.00	0.91	0.9052
18.3486	545.00	0.19	0.18611	11.8343	845.00	0.93	0.92613	8.7336	1145.00	0.90	0.9001
18.1818	550.00	0.29	0.29252	11.7647	850.00	0.82	0.81928	8.6957	1150.00	0.73	0.7309
18.0180	555.00	0.44	0.43977	11.6959	855.00	0.83	0.82747	8.6580	1155.00	0.87	0.8711
17.8571	560.00	0.75	0.74961	11.6279	860.00	0.92	0.92247	8.6207	1160.00	0.89	0.8897
17.6991	565.00	0.22	0.22343	11.5607	865.00	0.89	0.89132	8.5837	1165.00	0.74	0.7385
17.5439	570.00	0.22	0.22636	11.4943	870.00	0.89	0.89479	8.5470	1170.00	0.91	0.9053
17.3913	575.00	0.28	0.27790	11.4286	875.00	0.93	0.93079	8.5106	1175.00	0.63	0.6278
17.2414	580.00	0.16	0.16482	11.3636	880.00	0.89	0.89298	8.4746	1180.00	0.86	0.8642
17.0940	585.00	0.26	0.25829	11.2994	885.00	0.86	0.85936	8.4388	1185.00	0.66	0.6603
16.9492	590.00	0.03	0.03223	11.2360	890.00	0.90	0.90478	8.4034	1190.00	0.88	0.8804
16.8067	595.00	0.03	0.02967	11.1732	895.00	0.93	0.93370	8.3682	1195.00	0.90	0.9018
16.6667	600.00	0.12	0.11917	11.1111	900.00	0.93	0.93371	8.3333	1200.00	0.73	0.7333
16.5289	605.00	0.09	0.09463	11.0497	905.00	0.93	0.92541	8.2988	1205.00	0.89	0.8898
16.3934	610.00	0.12	0.11891	10.9890	910.00	0.88	0.88076	8.2645	1210.00	0.56	0.5647
16.2602	615.00	0.00	0.00155	10.9290	915.00	0.93	0.93121	8.2305	1215.00	0.87	0.8662
16.1290	620.00	0.00	0.00094	10.8696	920.00	0.89	0.89474	8.1967	1220.00	0.60	0.5963
16.0000	625.00	0.01	0.01187	10.8108	925.00	0.91	0.90807	8.1633	1225.00	0.48	0.4751
15.8730	630.00	0.00	0.00422	10.7527	930.00	0.93	0.93386	8.1301	1230.00	0.80	0.7991
15.7480	635.00	0.00	0.00036	10.6952	935.00	0.93	0.92819	8.0972	1235.00	0.69	0.6947

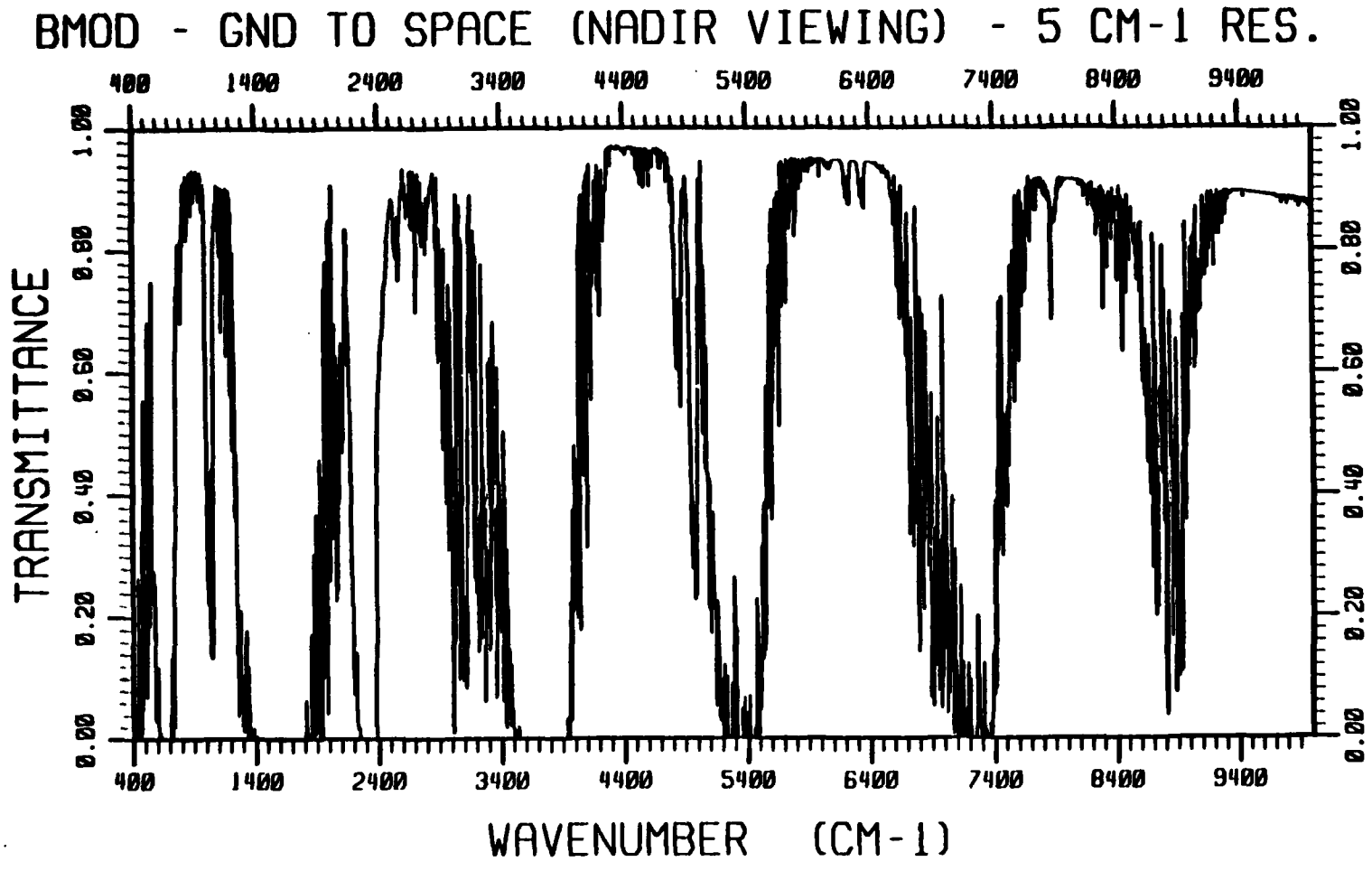
15.6250	640.00	0.00	0.00002	10.6383	940.00	0.92	0.91563	8.0645	1240.00	0.63	0.6314
15.5039	645.00	0.00	0.00000	10.5820	945.00	0.92	0.91630	8.0321	1245.00	0.36	0.3645
15.3846	650.00	0.00	0.00000	10.5263	950.00	0.88	0.88176	8.0000	1250.00	0.47	0.4698
15.2672	655.00	0.00	0.00000	10.4712	955.00	0.90	0.90026	7.9681	1255.00	0.39	0.3859
15.1515	660.00	0.00	0.00000	10.4167	960.00	0.93	0.93143	7.9365	1260.00	0.14	0.1390
15.0376	665.00	0.00	0.00000	10.3627	965.00	0.92	0.92262	7.9051	1265.00	0.17	0.1672
14.9254	670.00	0.00	0.00000	10.3093	970.00	0.89	0.89160	7.8740	1270.00	0.04	0.0393
14.8148	675.00	0.00	0.00000	10.2564	975.00	0.86	0.86480	7.8431	1275.00	0.21	0.2075
14.7059	680.00	0.00	0.00000	10.2041	980.00	0.91	0.90846	7.8125	1280.00	0.21	0.2116
14.5985	685.00	0.00	0.00000	10.1523	985.00	0.91	0.91246	7.7821	1285.00	0.14	0.1407
14.4928	690.00	0.00	0.00000	10.1010	990.00	0.89	0.89405	7.7519	1290.00	0.09	0.0897
14.3885	695.00	0.00	0.00002	10.0503	995.00	0.85	0.85229	7.7220	1295.00	0.08	0.0758

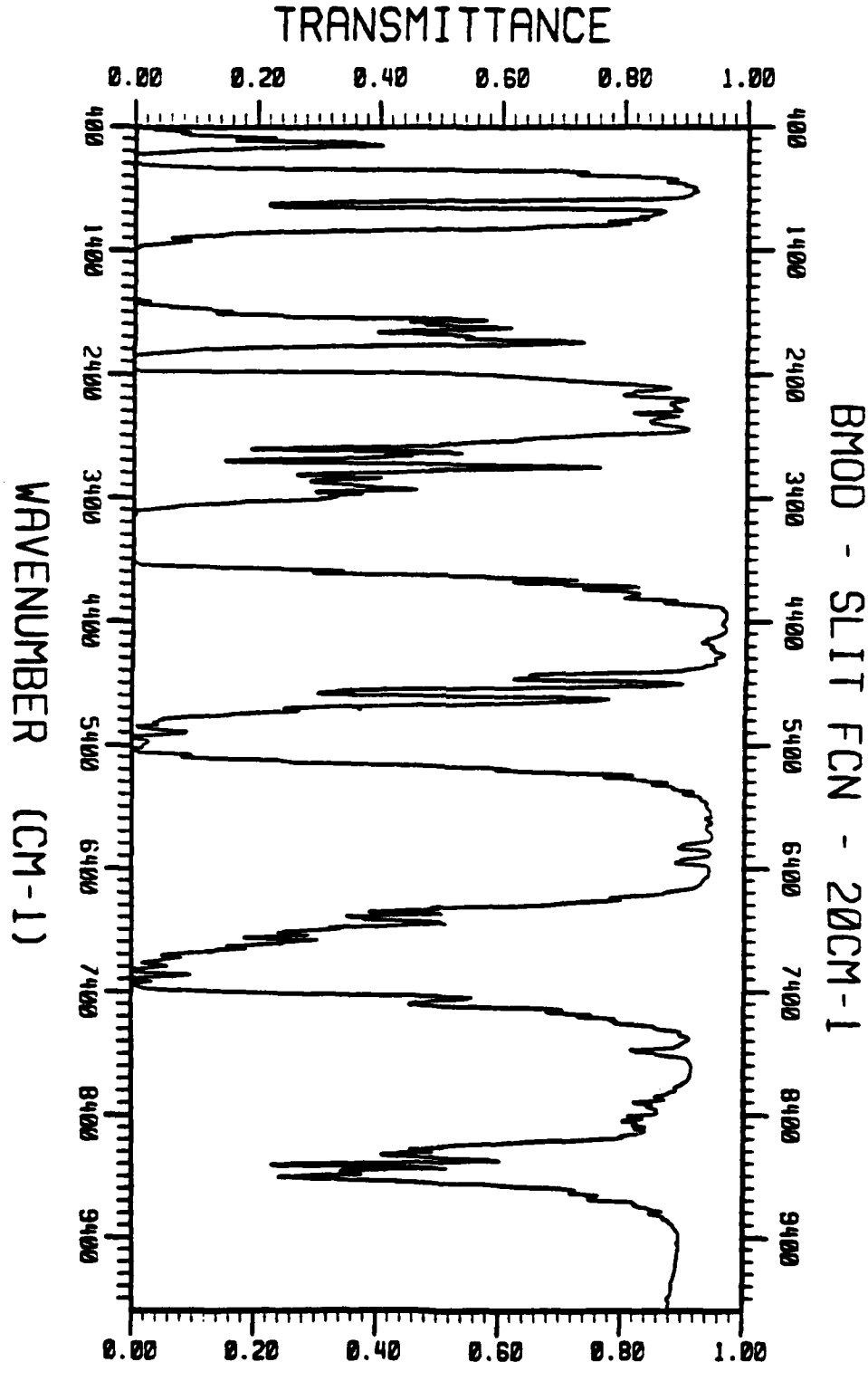
LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE	
7.6923	1300.00	0.10	0.10473	6.2500	1600.00	0.00	0.00441	5.2632	1900.00	0.37	0.3696
7.6628	1305.00	0.01	0.01362	6.2305	1605.00	0.00	0.00004	5.2493	1905.00	0.22	0.2175
7.6336	1310.00	0.11	0.10613	6.2112	1610.00	0.00	0.00000	5.2356	1910.00	0.02	0.0211
7.6046	1315.00	0.01	0.01281	6.1919	1615.00	0.00	0.00000	5.2219	1915.00	0.21	0.2055
7.5758	1320.00	0.02	0.02194	6.1728	1620.00	0.00	0.00000	5.2083	1920.00	0.00	0.0008
7.5472	1325.00	0.16	0.16494	6.1538	1625.00	0.00	0.00000	5.1948	1925.00	0.04	0.0424
7.5188	1330.00	0.18	0.17868	6.1350	1630.00	0.00	0.00000	5.1813	1930.00	0.46	0.4598
7.4906	1335.00	0.03	0.03198	6.1162	1635.00	0.00	0.00000	5.1680	1935.00	0.27	0.2719
7.4627	1340.00	0.00	0.00036	6.0976	1640.00	0.00	0.00000	5.1546	1940.00	0.24	0.2396
7.4349	1345.00	0.12	0.12078	6.0790	1645.00	0.00	0.00000	5.1414	1945.00	0.01	0.0052
7.4074	1350.00	0.07	0.06853	6.0606	1650.00	0.00	0.00000	5.1282	1950.00	0.43	0.4315
7.3801	1355.00	0.05	0.04999	6.0423	1655.00	0.00	0.00000	5.1151	1955.00	0.29	0.2850
7.3529	1360.00	0.01	0.00943	6.0241	1660.00	0.00	0.00000	5.1020	1960.00	0.37	0.3659
7.3260	1365.00	0.00	0.00107	6.0060	1665.00	0.00	0.00000	5.0891	1965.00	0.10	0.1001
7.2993	1370.00	0.01	0.00677	5.9880	1670.00	0.00	0.00000	5.0761	1970.00	0.74	0.7410
7.2727	1375.00	0.00	0.00045	5.9701	1675.00	0.00	0.00000	5.0633	1975.00	0.68	0.6774
7.2464	1380.00	0.02	0.01693	5.9524	1680.00	0.00	0.00000	5.0505	1980.00	0.78	0.7825
7.2202	1385.00	0.02	0.01950	5.9347	1685.00	0.00	0.00000	5.0378	1985.00	0.67	0.6717
7.1942	1390.00	0.00	0.00007	5.9172	1690.00	0.00	0.00000	5.0251	1990.00	0.04	0.0424
7.1685	1395.00	0.00	0.00000	5.8997	1695.00	0.00	0.00000	5.0125	1995.00	0.31	0.3066
7.1429	1400.00	0.00	0.00002	5.8824	1700.00	0.00	0.00000	5.0000	2000.00	0.52	0.5180
7.1174	1405.00	0.00	0.00060	5.8651	1705.00	0.00	0.00000	4.9875	2005.00	0.85	0.8513
7.0922	1410.00	0.01	0.00685	5.8480	1710.00	0.00	0.00000	4.9751	2010.00	0.49	0.4851
7.0671	1415.00	0.00	0.00136	5.8309	1715.00	0.00	0.00000	4.9628	2015.00	0.26	0.2590
7.0423	1420.00	0.00	0.00000	5.8140	1720.00	0.00	0.00000	4.9505	2020.00	0.37	0.3675
7.0175	1425.00	0.00	0.00002	5.7971	1725.00	0.00	0.00001	4.9383	2025.00	0.44	0.4420
6.9930	1430.00	0.00	0.00001	5.7803	1730.00	0.00	0.00000	4.9261	2030.00	0.91	0.9081
6.9686	1435.00	0.00	0.00000	5.7637	1735.00	0.00	0.00000	4.9140	2035.00	0.80	0.7965
6.9444	1440.00	0.00	0.00137	5.7471	1740.00	0.00	0.00000	4.9020	2040.00	0.33	0.3278
6.9204	1445.00	0.00	0.00259	5.7307	1745.00	0.00	0.00000	4.8900	2045.00	0.53	0.5288
6.8966	1450.00	0.00	0.00000	5.7143	1750.00	0.00	0.00000	4.8780	2050.00	0.67	0.6702
6.8729	1455.00	0.00	0.00000	5.6980	1755.00	0.00	0.00000	4.8662	2055.00	0.68	0.6815
6.8493	1460.00	0.00	0.00000	5.6818	1760.00	0.00	0.00000	4.8544	2060.00	0.47	0.4698
6.8259	1465.00	0.00	0.00000	5.6657	1765.00	0.00	0.00056	4.8426	2065.00	0.23	0.2281
6.8027	1470.00	0.00	0.00000	5.6497	1770.00	0.00	0.00000	4.8309	2070.00	0.63	0.6304
6.7797	1475.00	0.00	0.00000	5.6338	1775.00	0.00	0.00000	4.8193	2075.00	0.25	0.2462
6.7568	1480.00	0.00	0.00001	5.6180	1780.00	0.00	0.00000	4.8077	2080.00	0.34	0.3366
6.7340	1485.00	0.00	0.00000	5.6022	1785.00	0.00	0.00102	4.7962	2085.00	0.59	0.5893
6.7114	1490.00	0.00	0.00000	5.5866	1790.00	0.00	0.00008	4.7847	2090.00	0.39	0.3925

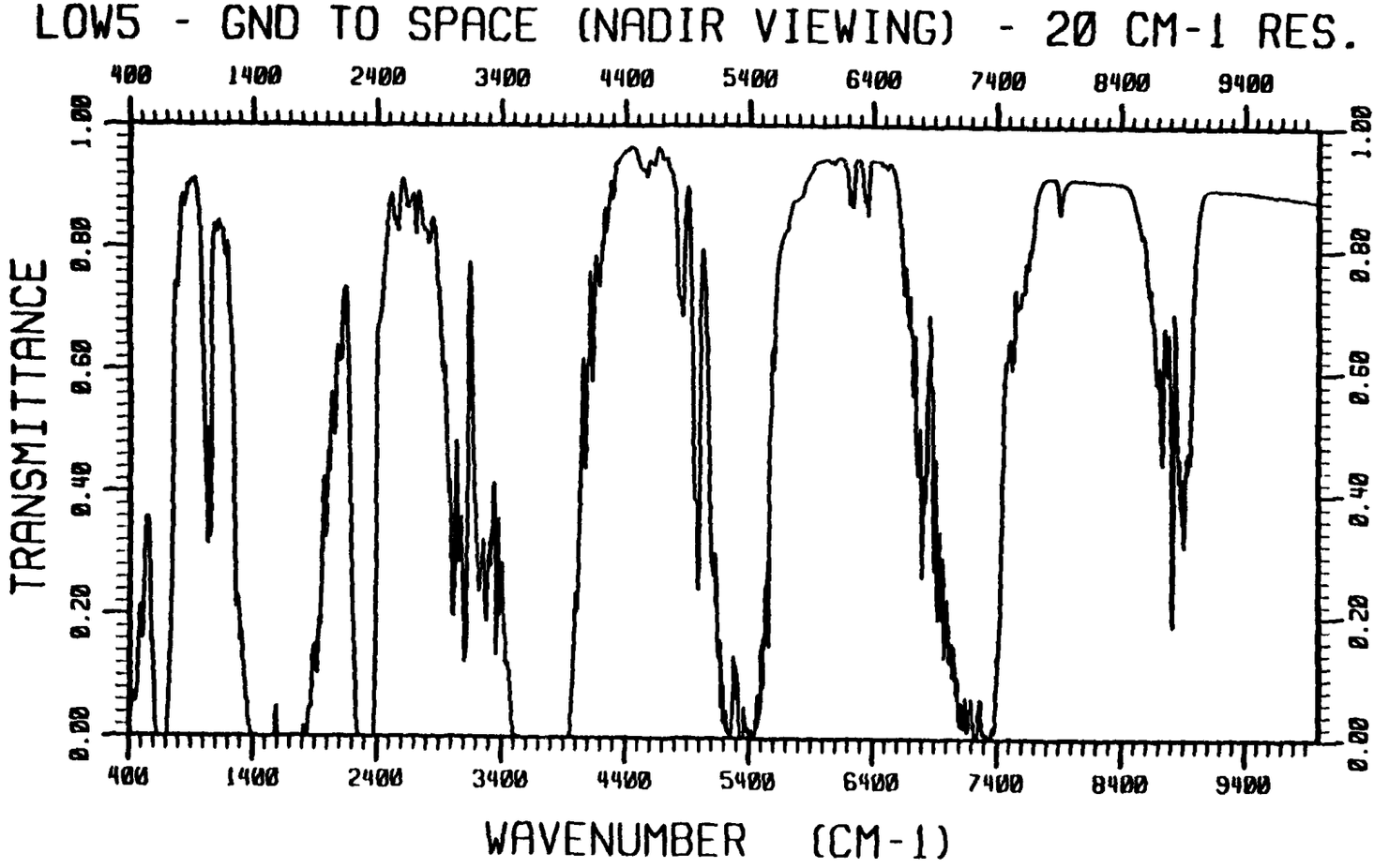
6.6898	1495.00	0.00	0.00000	5.5710	1795.00	0.00	0.00000	4.7733	2095.00	0.50	0.5022
6.6667	1500.00	0.00	0.00000	5.5556	1800.00	0.00	0.00000	4.7619	2100.00	0.63	0.6277
6.6445	1505.00	0.00	0.00000	5.5402	1805.00	0.02	0.01652	4.7506	2105.00	0.54	0.5351
6.6225	1510.00	0.00	0.00000	5.5249	1810.00	0.00	0.00038	4.7393	2110.00	0.65	0.6514
6.6007	1515.00	0.00	0.00000	5.5096	1815.00	0.07	0.06613	4.7281	2115.00	0.47	0.4685
6.5789	1520.00	0.00	0.00000	5.4945	1820.00	0.06	0.05660	4.7170	2120.00	0.51	0.5133
6.5574	1525.00	0.00	0.00000	5.4795	1825.00	0.00	0.00004	4.7059	2125.00	0.49	0.4870
6.5359	1530.00	0.00	0.00000	5.4645	1830.00	0.00	0.00000	4.6948	2130.00	0.63	0.6325
6.5147	1535.00	0.00	0.00000	5.4496	1835.00	0.00	0.00186	4.6838	2135.00	0.64	0.6365
6.4935	1540.00	0.00	0.00000	5.4348	1840.00	0.01	0.01180	4.6729	2140.00	0.73	0.7338
6.4725	1545.00	0.00	0.00000	5.4201	1845.00	0.00	0.00000	4.6620	2145.00	0.75	0.7495
6.4516	1550.00	0.00	0.00000	5.4054	1850.00	0.00	0.00377	4.6512	2150.00	0.84	0.8371
6.4309	1555.00	0.00	0.00000	5.3908	1855.00	0.18	0.17525	4.6404	2155.00	0.72	0.7199
6.4103	1560.00	0.00	0.00000	5.3763	1860.00	0.06	0.06120	4.6296	2160.00	0.61	0.6125
6.3898	1565.00	0.00	0.00000	5.3619	1865.00	0.01	0.01458	4.6189	2165.00	0.68	0.6845
6.3694	1570.00	0.00	0.00000	5.3476	1870.00	0.00	0.00241	4.6083	2170.00	0.66	0.6627
6.3492	1575.00	0.00	0.00000	5.3333	1875.00	0.13	0.12975	4.5977	2175.00	0.58	0.5784
6.3291	1580.00	0.00	0.00000	5.3191	1880.00	0.30	0.30474	4.5872	2180.00	0.54	0.5357
6.3091	1585.00	0.00	0.00344	5.3050	1885.00	0.10	0.10267	4.5767	2185.00	0.35	0.3504
6.2893	1590.00	0.00	0.00206	5.2910	1890.00	0.01	0.00896	4.5662	2190.00	0.27	0.2688
6.2696	1595.00	0.00	0.00088	5.2770	1895.00	0.03	0.02508	4.5558	2195.00	0.22	0.2199

1

LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE		LAMBDA MICRONS	V CM-1	TRANSMITTANCE	
4.5455	2200.00	0.16	0.16036	4.0000	2500.00	0.86	0.85578	3.5714	2800.00	0.79	0.7946
4.5351	2205.00	0.11	0.11148	3.9920	2505.00	0.87	0.86578	3.5651	2805.00	0.89	0.8902
4.5249	2210.00	0.07	0.07450	3.9841	2510.00	0.87	0.87326	3.5587	2810.00	0.89	0.8850
4.5147	2215.00	0.09	0.08871	3.9761	2515.00	0.87	0.87303	3.5524	2815.00	0.82	0.8193
4.5045	2220.00	0.09	0.08502	3.9683	2520.00	0.89	0.88550	3.5461	2820.00	0.89	0.8922
4.4944	2225.00	0.14	0.14412	3.9604	2525.00	0.88	0.88429	3.5398	2825.00	0.87	0.8719
4.4843	2230.00	0.05	0.04750	3.9526	2530.00	0.88	0.87512	3.5336	2830.00	0.89	0.8885
4.4743	2235.00	0.02	0.02120	3.9448	2535.00	0.85	0.85241	3.5273	2835.00	0.91	0.9085
4.4643	2240.00	0.02	0.01747	3.9370	2540.00	0.84	0.84158	3.5211	2840.00	0.90	0.9022
4.4543	2245.00	0.02	0.02016	3.9293	2545.00	0.80	0.80235	3.5149	2845.00	0.90	0.8976
4.4444	2250.00	0.01	0.00609	3.9216	2550.00	0.80	0.79859	3.5088	2850.00	0.92	0.9182
4.4346	2255.00	0.01	0.00744	3.9139	2555.00	0.79	0.78883	3.5026	2855.00	0.90	0.8985
4.4248	2260.00	0.00	0.00110	3.9063	2560.00	0.85	0.85367	3.4965	2860.00	0.93	0.9286
4.4150	2265.00	0.00	0.00041	3.8986	2565.00	0.86	0.85837	3.4904	2865.00	0.88	0.8823
4.4053	2270.00	0.00	0.00009	3.8911	2570.00	0.79	0.79141	3.4843	2870.00	0.92	0.9158
4.3956	2275.00	0.00	0.00009	3.8835	2575.00	0.75	0.75197	3.4783	2875.00	0.86	0.8599
4.3860	2280.00	0.00	0.00009	3.8760	2580.00	0.77	0.77364	3.4722	2880.00	0.91	0.9076
4.3764	2285.00	0.00	0.00003	3.8685	2585.00	0.83	0.82671	3.4662	2885.00	0.80	0.8027
4.3668	2290.00	0.00	0.00000	3.8610	2590.00	0.87	0.86940	3.4602	2890.00	0.92	0.9218
4.3573	2295.00	0.00	0.00000	3.8536	2595.00	0.89	0.89243	3.4542	2895.00	0.63	0.6321
4.3478	2300.00	0.00	0.00000	3.8462	2600.00	0.90	0.90241	3.4483	2900.00	0.82	0.8229
4.3384	2305.00	0.00	0.00000	3.8388	2605.00	0.90	0.90016	3.4423	2905.00	0.62	0.6171
4.3290	2310.00	0.00	0.00000	3.8314	2610.00	0.91	0.90765	3.4364	2910.00	0.84	0.8391
4.3197	2315.00	0.00	0.00000	3.8241	2615.00	0.93	0.93487	3.4305	2915.00	0.65	0.6511
4.3103	2320.00	0.00	0.00000	3.8168	2620.00	0.88	0.88403	3.4247	2920.00	0.71	0.7104
4.3011	2325.00	0.00	0.00000	3.8095	2625.00	0.88	0.88451	3.4188	2925.00	0.63	0.6287
4.2918	2330.00	0.00	0.00000	3.8023	2630.00	0.91	0.91293	3.4130	2930.00	0.73	0.7337
4.2827	2335.00	0.00	0.00000	3.7951	2635.00	0.87	0.87090	3.4072	2935.00	0.48	0.4754
4.2735	2340.00	0.00	0.00000	3.7879	2640.00	0.85	0.85264	3.4014	2940.00	0.65	0.6486


BMOD - GND TO SPACE (NADIR VIEWING) - 5 CM-1 RES.
400
1400
2400
3400
4400
5400
6400
7400
8400
9400
TRANSMITTANCE
0.00
0.20
0.40
0.60
0.80
1.00
WAVENUMBER (CM-1)


TRANSMITTANCE
0.00
0.20
0.40
0.60
0.80
1.00
400
1400
2400
3400
4400
5400
6400
7400
8400
9400
WAVENUMBER (CM-1)
BMOD - SLIT FCN - 20CM-1


LOW5 - GND TO SPACE (NADIR VIEWING) - 20 CM-1 RES.
400
1400
2400
3400
4400
5400
6400
7400
8400
9400
TRANSMITTANCE
0.00
0.20
0.40
0.60
0.80
1.00
WAVENUMBER (CM-1)

APPENDIX F

SUGGESTED IMPLEMENTATION PROCEDURE

F. SUGGESTED IMPLEMENTATION PROCEDURE

The following procedure is suggested to get the modified version of LOWTRAN5 operational.

1. Read the Tape

The 9-track 800 BPI EBCDIC tape, supplied by Aerodyne Research, Inc., contains the following information.

FILE NO.	DESCRIPTION	RECORD LENGTH	BLOCK SIZE	NO. OF BLOCKS
1	SOUCE LISTING OF MODIFIED LOWTRAN5	80	800	435
2	BINARY TRANSLATION PROGRAM	80	800	5
3	FORMATTED BAND MODEL PARAMETERS	120	1200	769
4	TEST CASE INPUT	80	800	3
5	TEST CASE OUTPUT	132	1320	76

2. Convert Formatted Band Model Parameters to Binary

Once the tape has been successfully read onto the user's system, the formatted band model parameters (file 3) should be converted to a binary file. It is assumed at this point that the user has created a disc file containing the formatted band model parameters. The conversion to binary is accomplished by using the program in file 2. The source listing of this program can be found in Appendix G. The user has the option of converting only a subset of the band model parameters to binary if storage space and/or storage

charges are a problem. Instructions for using the binary conversion program are included in the source listing. Once the binary conversion is completed, the user can delete the formatted band model parameter from the system.

3. Compilation and Modification of Source Program

Before attempting compilation of the source program in file 1 the user should obtain a listing and compare it to the one enclosed in this report. Furthermore, the user should read all of Section 3 of this report in order to decide what specific lines of code must be modified in order to be compatible with his system. If the user already has a version of LOWTRAN5 operational, it is possible, although not recommended, to implement the BMOD option by making only the required modifications outlined in Section 3.

Users with a CALCOMP compatible plotter should find it straightforward to utilize the enclosed plotting package. The modifications required are outlined in subsection 3.3.1 and Appendix A. If the user decides to not use the plotting package, the statements listed in Table A.2 should be commented out.

The Aerodyne plot package uses file 9 to write the data (in binary) for subsequent use in plotting. Since file 7 (the regular LOWTRAN5 output file) has formatted data, it was decided not to change its format in case the user already has a plot package that uses file 7. We have commented out the references to file 7, since it is not used in our version. It is easily activated by removing the comments from the following lines:

```
LOW 1239, LOW 228-2310, LOW 2380
TRA 2330, TRA 2420
```

The word size for Hollerith formats on the PRIME 400 is 4 characters while it is 6 and 10 respectively for UNIVAC and CDC machines. We have changed some literals in LOWTRAN5 from 10 characters to 8 by defining HZ, SEASN and VULCN as double precision. If this format is not compatible with the user's machine (e.g., CDC and UNIVAC), the following statements must be appropriately modified:

```
LOW  1119
NSM    61, 340-370
HPR    51
GEO    71
ANG    11
POI    21
EXA    51
PAT    61
TRA    51
ATR    51
BMD    70
BMO   100
BLK    20, 2390-2480
LIB   270, 360-400, 510, 511, 1080, 1370, 1390
PRO   190, 320-330
```

4. Run the Test Case

Run the sample case to verify that the code is operating as expected. The input and output are both on the tape (Files 4 and 5, respectively), and correspond to the first sample case in Appendix E. These cases can be run before getting the plots operational by setting MPLT = 0. When MPLT = 0, no calls to external plotting subroutines are made. The test case is for an

observer at 100 km looking at the earth surface. Both transmittance and radiation are calculated for the 1900-2500 cm^{-1} spectral region. Three cases are calculated:

1. BMOD option (JBMOD = 1)
2. Slit Function (MODEL = 0)
3. Regular LOWTRAN5 (JBMOD = 0)

Plots from these three cases are also in Appendix E.

APPENDIX G

FORMATTED TO BINARY TRANSLATION PROGRAM

```
C     PROGRAM BINWRT(TAPE5,TAPE6)
C     FORMATTED READ AND BINARY WRITE MODULE FOR THE BAND MODEL
C     MODIFICATION OF LOWTRAN 5  (OCTOBER 1980)
C
      DIMENSION SD(5,4,20),OD(5,4,20),ZMWT(4,20),ALFO(4,20),TBAND(5)
      DATA KSPEC/4/,NOUT/6/,NIN/5/
C
C     FILE UNIT NUMBERS: NIN  = 5  (FORMATTED DATA FILE)
C                        NOUT = 6  (BINARY DATA FILE)
C
C     READ TAPE HEADER
      READ (NIN,600) VA,VB,NV,NTEMP,(TBAND(N),N=1,NTEMP)
C
C     IF ONLY A SUBSET OF THE TAPE IS WANTED ON THE BINARY FILE, MODIFY
C     THE VALUES OF VBOT AND VTOP BELOW TO THE DESIRED RANGE.
C     THE DEFAULT VALUES ARE:
C                VA = 400. CM-1        AND       VB = 9995. CM-1
C     (VA AND VB ARE THE VALUES ON THE TAPE HEADER.)
C     SINCE THE TAPE IS BLOCKED IN GROUPS OF 20 WAVENUMBER POINTS, VBOT
C     SHOULD BE A MULTIPLE OF 100 AND VTOP SHOULD BE XX95.
      VBOT = VA
      VTOP = VB
C     CHECK FOR 100 CM-1 BLOCKS IN CASE VBOT.NE.VA OR VTOP.NE.VB
      VBOT = 100.*INT(VBOT/100.+0.001)
      VTOP = 100.*INT(VTOP/100.+0.001) + 95.
      IF (VBOT.LE.VA) VBOT = VA
      IF (VTOP.GE.VB) VTOP = VB
      WRITE (NOUT) VBOT,VTOP,NV,NTEMP,(TBAND(N),N=1,NTEMP)
C
C     DETERMINE BLOCK NOS. IN WHICH VBOT & VTOP FALL
      ILOW = INT((VBOT-VA)/100.+0.001) + 1
      IHI  = INT((VTOP-VA)/100.+0.001) + 1
C
      DO 10 IBLK=1,IHI
      READ(NIN,610) (((SD(N,K,IW),OD(N,K,IW),N=1,NTEMP),ALFO(K,IW),
     &      ZMWT(K,IW),K=1,KSPEC),IW=1,20)
      IF (IBLK.LT.ILOW) GO TO 10
      WRITE (NOUT) (((SD(N,K,IW),OD(N,K,IW),N=1,NTEMP),ALFO(K,IW),
     &      ZMWT(K,IW),K=1,KSPEC),IW=1,20)
10    CONTINUE
      ENDFILE NOUT
C
      STOP
600   FORMAT(2F10.0,2I5,5F5.0)
610   FORMAT(10E10.3,F10.3,F10.1)
      END
```